Prepared for:
San Jacinto River Fleet, LLC
P.O. Box 878
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DRAFT SAMPLING AND ANALYSIS PLAN FOR PRE-CONSTRUCTION BASELINE SITE ASSESSMENT SAN JACINTO RIVER FLEET PROPERTY, HARRIS COUNTY, TEXAS

TWE Project Number 11.12.051

February 2012

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DRAFT SAMPLING AND ANALYSIS PLAN FOR
PRE-CONSTRUCTION BASELINE SITE ASSESSMENT
SAN JACINTO RIVER FLEET PROPERTY, HARRIS COUNTY, TEXAS

1.0 Introduction

This Sampling and Analysis Plan (SAP) has been prepared on behalf of San Jacinto River Fleet (SJRF), pursuant to the requirements of a pending agreed order, between SJRF and the U.S. Environmental Protection Agency (USEPA). The agreed order directs SJRF to prepare and execute a Sampling and Analysis Plan (SAP) for a Pre-Construction Baseline Site Assessment at property recently acquired by SJRF. The SJRF Property comprises exposed land and submerged land surrounding the San Jacinto River Waste Pits (SJRWP) Superfund Site in Harris County, Texas (Figure 1-1). The EPA order provides a vehicle for SJRF to avoid liability under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) for barge operation that might potentially remobilize sediment contaminated with dioxins and furans that originated from the Superfund site. Hence, the issues addressed in this SAP do not include waste streams newly generated by SJRF but existing environmental impact that could be disturbed by SJRF's commercial operations. Terms of the agreed order include the installation of a series of pylons that will prevent barges from drifting into and damaging the cap that has been installed on the SJRWP Superfund site. These pilings will be installed along lines that will constrain barge traffic to specified operating areas owned by SJRF. Tolunay-Wong Engineers, Inc., (TWE) has been retained by SJRF to develop and execute the SAP for the area where barge operations will take place.

In order to maintain consistency with data acquisition efforts for the SJRWP Superfund Site, this SAP draws heavily from the SAP developed for the Superfund site. As such, the Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP) for this pre-construction baseline site assessment conform largely with that for the Superfund site and are, therefore, consistent with applicable EPA guidance documents.

This SAP is arranged into the following sections.

- **Introduction:** Discusses project organization, site history, statement of problem and project objectives, chemicals of concern, personnel qualifications, and record keeping.
- **Conceptual Site Model:** Summarizes aspects of the SJRWP conceptual site model that are relevant to the SJRF Property.
- **Quality assurance Program Plan (QAPP):** Describes field and laboratory methods for insuring that data is representative and defensible.
- **Field Sampling Plan (FSP):** Describes details of sample collection, processing and chain-of-custody.

1.1 Project Organization

Figure 1-2 illustrates the organization of personnel on the project including project management and oversight, fieldwork, sample analysis, and data management.

Figure 1-1 – Location of Future SJRF Barge Dock Mainland Within Preliminary Site Perimeter of SJRWP Superfund Site

Tolunay-Wong Engineers, Inc.
Houston, Texas

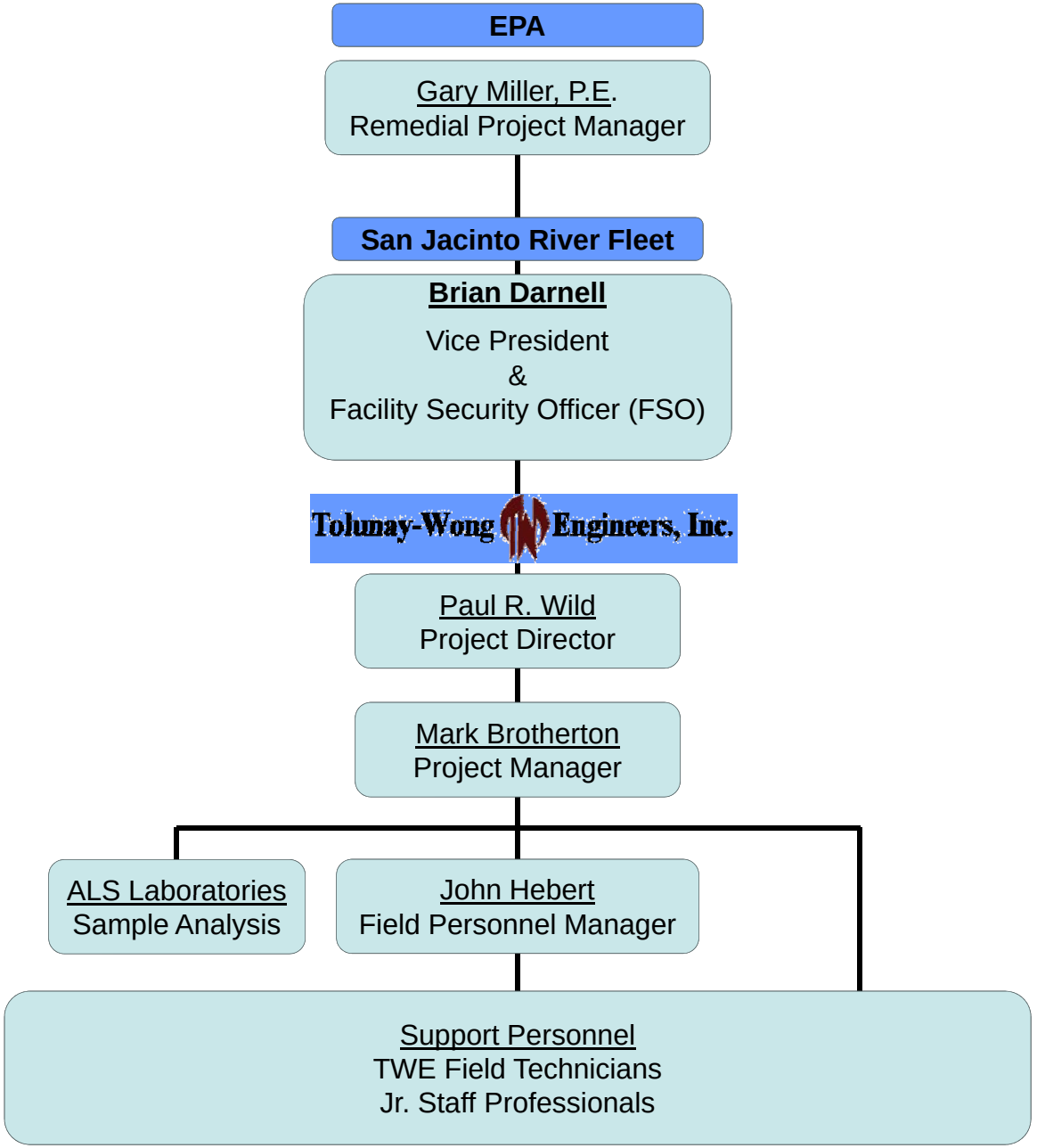
0 800
Scale in Feet

Project: Work Plan For Preconstruction Site Assessment
Future San Jacinto River Fleet Barge Dock,
Harris County, Texas
18001 I-10 Channelview, Harris County, Texas

Client: San Jacinto River Fleet, LLC
Channelview, Texas

Project No.: 11.12.014

Figure 1-2: Organization Chart for SJRF Property Baseline Site Assessment



1.2 Site History

The SJRF Property comprises exposed land and submerged land situated immediately west and north of the SJRWP Superfund Site. Hence, the site history that is germane to the SJRF Property and future barge docking activities focuses on the site history of the Superfund site. An extensive history of the area is provided in the SAP for the SJRWP Superfund Site (Integral & Anchor QEA, April 2010). Only the salient points as they relate to the SJRF Property will be provided here.

In the 1960's, the Champion Paper Co. (currently International Paper Co.) disposed dioxin laden paper mill waste in a partitioned impoundment located in the exposed land east of the SJRF Property. At the time, the two properties were one continuous land mass and were fully exposed above the water level. Subsequent land subsidence resulting from groundwater withdrawal in the 1970s contributed to the sinking of the impoundment along with much of the bank areas along the San Jacinto River. As a result, contaminated material from the impoundment berm and from within the impoundment was subject to mobilization and redistribution by erosion resulting from tidal and river currents. Also, dredging operations took place through sand mining operations in the area between the two sites. Thus, through natural and anthropogenic means, contaminated sediment was potentially distributed to the surrounding surface water and sediment, thereby becoming potentially accessible to ecological receptors and site visitors. Of relevance to barging operations is that contaminants in the near-surface, biologically active and/or physically mixed zone may become remobilized from sediment resuspension due to barge traffic. Once in the water column, additional contaminant transport upstream or downstream can occur leading to further biological uptake from suspended sediments and associated surface water.

As noted above, chemicals associated with the area surrounding the SJRF Property are expected to be exclusively those associated with solid wastes produced by bleached kraft pulp mill operations and disposed at the Superfund site. Chemistry data for sediment samples collected from the SJRWP Superfund Site and surrounding areas show that dioxins and furans are present in sediments in and near the impoundments at high concentrations but decline significantly with distance from the Superfund site (Figure 1-3).

Determining the potential for resuspension of contaminated sediment to occur is the one issue that will be addressed in this baseline site assessment.

1.3 Problem Definition and Project Objectives

Based on the area history, the SJRF Property is incidentally associated with the SJRWP Superfund Site which was added to the National Priorities List (NPL) on March 19, 2008. The investigation described in this SAP is not intended to supplement that investigation but is intended to establish the present status of the SJRF Property with respect to the ongoing investigation at the Superfund site so that future liability can be averted with regard to remobilizing dioxin contamination sediment from barge activities. For this reason, determining nature and extent are not at issue, nor is defining risk to human and ecological receptors an

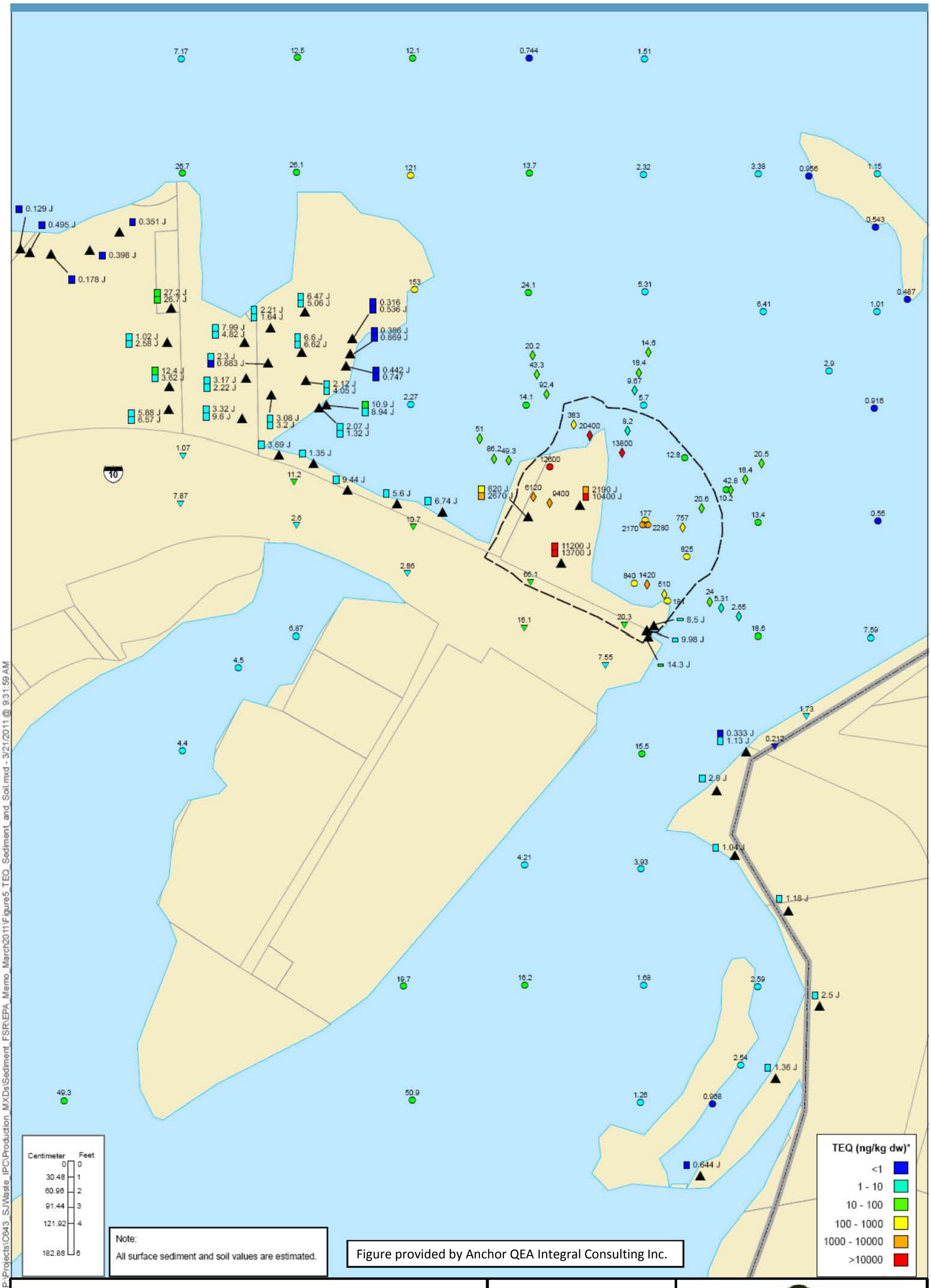


Figure provided by Anchor QEA Integral Consulting Inc.

Figure 1-3 – Third Party Sediment and Soil Sampling Results for SJRWP Superfund Site and Surrounding Areas

Tolunay-Wong Engineers, Inc.
Houston, Texas

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Scale in Feet

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Client: San Jacinto River Fleet, LLC
Channelview, Texas

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objective. Whereas these are endpoint objectives for the Superfund site, they are the starting points for the baseline assessment that SJRF will conduct.

In order to avoid CERCLA liability, EPA requires that a series of baseline samples be collected before SJRF commence facility construction for barging operations. As per EPA guidance, any sampling effort will need to address environmental issues associated with sediment remobilization accompanying barge traffic and potential contamination redistribution associated with pylon installation efforts that disturb sediment in submerged lands. As noted above, hollow steel tubes will be used as pylons, resulting in minimal disturbance of sediment. Activities that will be conducted to meet these objectives will include:

- establishing pylon locations based on the proposed routing and spacing of pylons;
- selecting key pylon locations for sediment sampling efforts;
- developing a method for selecting and establishing sample locations for annual sediment monitoring along the main channel.
- defining a sampling methodology for collecting representative samples of soft sediment;
- prescribing an analytical program that characterizes contaminant concentrations in sediment at a level that can adequately evaluate ecological exposure; and,
- reporting to establish a baseline characterization of sediment with follow-up reports that reflect annual monitoring results.

1.4 Chemicals of Concern and Analytical Methods

1.4.1 Chemicals of Concern

The determination of Chemicals of Concern (COC) is a function of how potential receptors under consideration might respond to constituents that have been released from the Superfund site. Since the objective of the pre-construction baseline site assessment focuses exclusively on sediment, humans are not included in the list for the SJRF Property. Further, through preliminary screening efforts published in the SAP for the SJRWP Superfund Site (Integral & Anchor QEA, April 2010), benthic communities have been eliminated from consideration because the highest levels of COCs detected during previous sampling efforts show no measureable effect on them. However, the aspect of bioaccumulation on ecological receptors higher up the food chain has not been established, so fish and wildlife have been retained as potential receptors. Within this context, only dioxins and furans have been established as a primary COC for the Superfund site and surrounding areas.

TCEQ does not provide a dioxin screening value, so the scientific literature was reviewed for appropriate dioxin benchmark(s) that could be used to screen sediment data for the Site. Preference was given to benchmarks that were empirically derived, relevant to marine/estuarine sediments, and provided a concentration associated with no effect in the tested organism. Proposed sediment quality guidelines and benchmarks for dioxins have been promulgated by a variety of institutions and agencies, and many have been compiled by Wenning et al. (2004). Several benchmarks, based on equilibrium partitioning or other predicted relationships between sediments and receptors, were not considered significantly robust, probably due to a lack of empirical support. The screening value chosen for the Superfund site and therefore for the SJRF Property is 25 µg/kg. This value represents a spiked sediment 10-day toxicity test using the

marine amphipod Ampelisca abdita (Barber et al. 1998). In that study, 25 µg/kg 2,3,7,8-TCDD was the highest concentration to which the amphipod was exposed, and no significant effects on either survival or growth were found. The amphipod used in that study is considered a representative, sensitive marine benthic invertebrate species. Stated in units used for the SJRWP site, 25 µg/kg translates to units of 25,000 ng/kg. As of the writing of the SJRWP SAP, the highest dioxin concentration analyzed to date through third party sampling at the Superfund site was 18,500 ng/kg (reported as toxicity equivalent (TEQ) units). It should be noted that this is about two to four orders of magnitude greater than any third party sampling results for submerged land away from the Superfund site. As the baseline risk assessment for fish and wildlife as yet to be completed for the SJRWP SAP, a screening value for this ecological group was not established as of the writing of this SAP.

1.4.2 Analytical Methods

Dioxins and furans in sediment samples will be extracted and analyzed in accordance with USEPA Method 8290A as described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)* (USEPA 2008a). Samples will be analyzed by high-resolution gas chromatography with high-resolution mass spectrometry (HRGC/HRMS) (Table 1-1). Analytical preparation methods and procedures to be performed will be in accordance with the project laboratory's QAPP and Standard Operating Procedures (SOPs). All extracts will undergo silica gel cleanup with additional cleanup procedures used as necessary. Detection limits are calculated on an individual compound and sample basis and depend on the signal-to-background ratio for the specific labeled isomer. Data for this project will be reported in context with method detection limit (MDL), Sample Detection limit (SDL), and Method Quantiation limit (MQL) discussed in Section 3.3.

Table 1-1
Analytical Methods for Dioxins and Furans

Sample Preparation		Quantitative Analysis	
Protocol	**Procedure**	**Protocol**	**Procedure**
EPA 1613B/8290A	Soxhlet	EPA 1613B/8290A	High Res GC/High Res MS

1.5 Special Training and Certification

A technical team will be assembled with the requisite experience and technical skills to successfully complete the 2012 sediment study. All technical team personnel involved in sample collection will have extensive environmental sampling experience and will have completed the 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) standard training course and 8-hour refresher courses. Documentation of course completion will be maintained in personnel files.

The laboratory chosen for this project holds certification through the National Environmental Laboratory Accreditation Program for the methods which that laboratory will perform, where applicable.

1.6 Documents and Records

Records will be maintained documenting all activities and data related to sample collection and laboratory analyses. Results of data verification and validation will also be documented. Types of documentation for this project are listed here but will be described in greater detail in the QAPP and the FSP. The QAPP, FSP, and the HASP (Attachment 1) for this sediment study will be provided to every task participant listed in Section 1.1. Any revisions or amendments to any of the documents that make up the SAP will also be provided to these individuals.

1.6.1 Field Records

Details of field documentation are discussed in Section 4.7 of the FSP. Field records that will be maintained include the following:

- Field logbooks
- Photo documentation
- Field data and sample collection information
- Field change request forms (as needed)
- Sample tracking/chain-of-custody (COC) forms

Observations recorded in the field logbook will be used to provide context for presentation and interpretation of analytical results.

1.6.2 Laboratory Data Reports

All activities and results related to sample analysis will be documented by the laboratory. Internal laboratory documentation procedures are described in the laboratory QA manuals. Each data package will contain all information required for a complete QA review, including the following:

- A cover letter discussing analytical procedures and any difficulties that were encountered;
- A case narrative referencing or describing the procedures used and discussing any analytical problems and deviations from SOPs and this QAPP;
- COCs and cooler receipt forms;
- A summary of analyte concentrations (to two significant figures, unless otherwise justified), method detection limits (MDLs), sample detection limits (SDLs), and method quantitation limits (MQL);
- Laboratory data qualifier codes appended to analyte concentrations, as appropriate, and a summary of code definitions;
- Sample preparation, digestion, extraction, dilution, and cleanup logs;
- Instrument tuning data;
- Initial and continuing calibration data, including instrument printouts and quantification summaries, for all analytes;
- Results for method and calibration blanks;

- Results for all QA/QC checks, including but not limited to labeled compounds, surrogate spikes, internal standards, serial dilutions, laboratory control samples, matrix spike samples, matrix spike duplicate samples, and laboratory duplicate samples provided on summary forms;
- Instrument data quantification reports for all analyses and samples;
- Summaries of out-of-control laboratory QC data and any corrective actions implemented;
- Descriptions and justification for any significant changes in methodology or QA/QC procedures; and,
- Copies of all laboratory worksheets and standards preparation logs.

Data will be delivered by the laboratories in both hard copy and electronic format to the TWE project manager, who will be responsible for oversight of data verification and validation and for archiving the final data and data quality reports in the project file.

1.6.4 Reports and Deliverables

Once all field programs for the Site are complete, a draft Baseline Site Assessment Report (BSAR) will be prepared and submitted to USEPA. The draft BSAR will contain sample location maps, validated analytical chemistry results, and recommendations on any changes that would benefit SJRF's commercial operations. The draft BSAR will be submitted to USEPA within 30 days after the completion of all laboratory and data validation work for the field study outlined here.

2.0 Conceptual Site Model

The SJRF Property is physically located within the "preliminary Site perimeter" of the San Jacinto River Waste Pits Superfund Site (Figure 2-1). Hence in order to maintain compatibility with the Superfund site, parts of the Conceptual Site Model (CSM) presented for that site in the ***Final Remedial Investigation/Feasibility Study Work Plan, San Jacinto River Waste Pits Superfund Site*** (Anchor QEA, LLC, November 2010) are presented here to serve as a basis of a CSM for the SJRF Property Site. Inasmuch as the CSM for the Superfund site targets the release point of dioxins, its application to the SJRF Site is indirect, with the latter serving more as a component interim receptor than a distribution point. In that context, the CSM for the SJRF Property will concentrate on potential redistribution of impacted sediments that source from the Superfund Site. In addition, the CSM for the SJRF Site draws on the analysis of the Public Health Assessment provisionally issued by the Agency for Toxic Substances and Disease Registry (Texas Department of State Health Services, April 2011) and applied to the SJRF Property in the ***Phase I Environmental Site Assessment Big Star Property 18001 East Interstate 10 Channelview, Harris County, Texas*** completed by Tolunay-Wong in May 2011.

The purpose of a Conceptual Site Model (CSM) is to provide a succinct depiction of the sources of contaminants, the physical/chemical processes that control chemical transport and fate over time and space, and the exposure pathways that potentially lead to exposure and adverse effects to ecological and human receptors. CSMs are a key component of the site assessment process because they illustrate the links between site investigation data and the assessment of risk (ASTM 1995). As stated in the CSM for the Superfund site, CMSs also establish a context for evaluating potential site-associated sources and risk versus non site associated sources and risk. The latter point is the key to establishing a CSM for the SFRF Property Site because from SJRF's perspective, the Superfund site represents a non Site source and risk.

Figure 2-2 is a general CSM pathway diagram that shows the major sources, release mechanisms/transport pathways, exposure media, and potential human and ecological receptors of concern. It has been modified from it original form to apply to the SJRF Site. This CSM is focused on the characteristics of the primary COCs and indicator chemical group originating from the SJRWP Site - dioxins and furans. The following paragraphs summarize the chemical properties and behavior of dioxins and furans in the environment and release mechanisms/transport process that can be expected. Because the primary objective for this work plan is to assess sediment impact in submerged lands and along the main channel adjacent to the barge docking facility, this CMS targets the remobilizing of contaminated sediment. As such, impacted sediment in exposed land is not addressed.

2.1 COC Characteristics and Fate and Transport

Dioxins and furans are a family of polychlorinated organic chemicals with similar chemical Structures having extremely low vapor pressures and high partitioning coefficients (K_{ow} and K_{oc}) causing them to have extremely low water solubilities and a strong affinity for sediment, particularly sediment with high organic content. This results in the vast majority of dioxins and furans being strongly sorbed onto particulate matter, i.e., sediment and its associated organic matter. After being sorbed to the sediment organic phase, they exhibit little potential for

Figure 2-1 – Location of Future SJRF Barge Dock Mainland Within Preliminary Site Perimeter of SJRWP Superfund Site

Tolunay-Wong Engineers, Inc.
Houston, Texas

0 800
Scale in Feet

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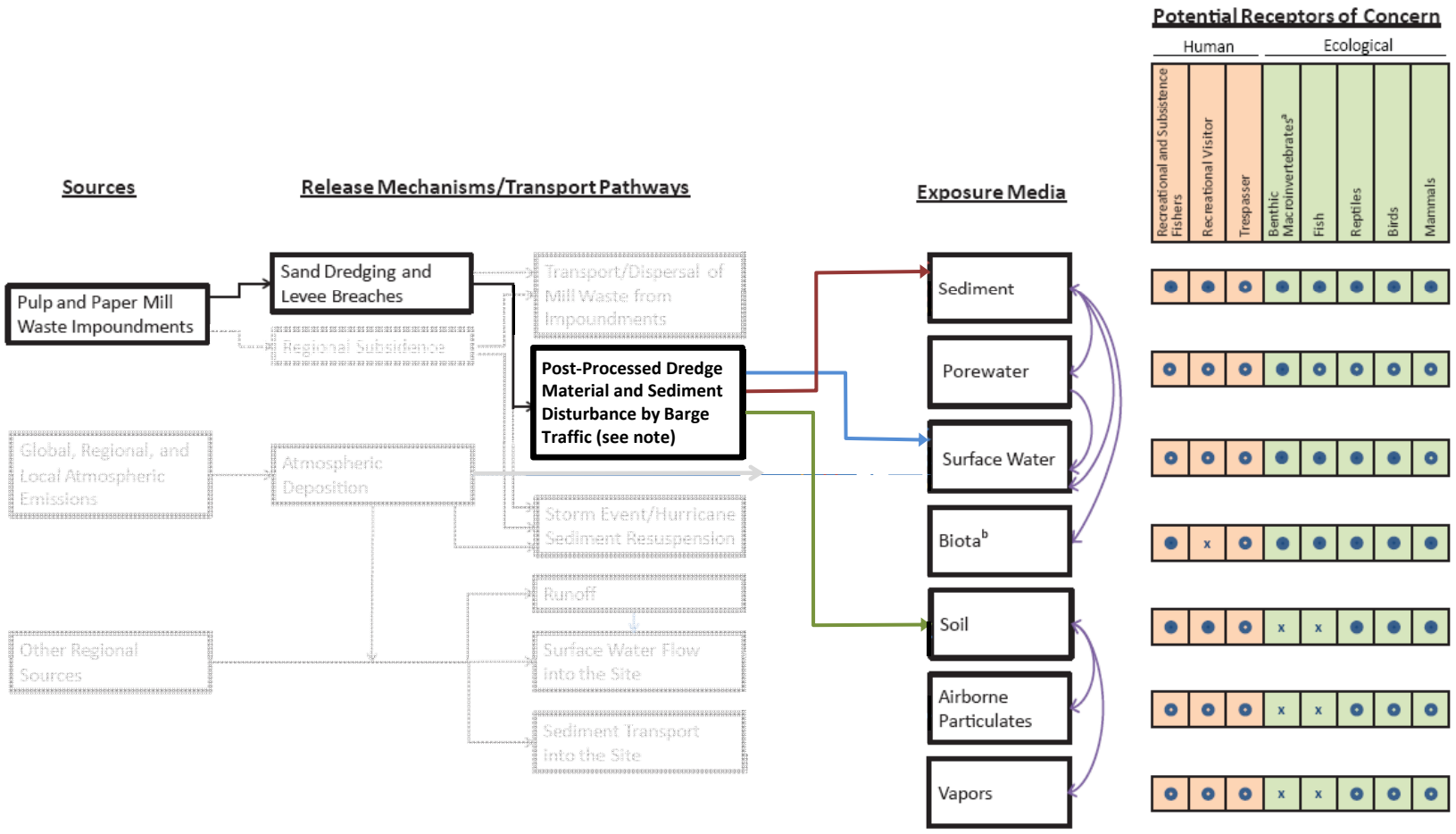

Notes:

Modified from Figure 4-1 in RI/FS Work Plan for Superfund Site

Curved lines indicate potential transport pathways for chemicals of potential concern among exposure media.

[a] Benthic invertebrates include crabs and other crustaceans and shellfish consumed by all receptors, as well as polychaetes and other infauna consumed by fish, other marine life, birds and mammals.

[b] Biota consumed by human receptors are expected to be fish and shellfish.

From: ***Final Remedial Investigation/Feasibility Study Work Plan San Jacinto River Waste Pits Superfund Site*** (Anchor QEA, LLC, November 2010)

Figure 2-2 – Conceptual Site Model Pathway Diagram for SJRF Site (modified from SJRWP CSM)

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Houston, Texas

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Channelview, Texas

leaching or volatilization and become highly stable in an abiotic environmental media, with persistence typically measured in decades. While in the sediment medium, chemical degradation of dioxins and furans can occur through reductive dechlorination. Recent research in the San Jacinto estuary found widespread occurrence of known dioxin degrading bacteria, Dehalococcoides spp., in sediment throughout the Houston Ship Channel and Galveston Bay (Louchouarn and Brinkmeyer 2009). These bacteria use polychlorinated compounds as electron acceptors in the anaerobic process of dehalorespiration (Bunge et al. 2003; Holliger et al. 1999; Adrian et al. 2000). Anaerobic, sulfate-reducing conditions and relatively high bulk organic carbon levels reported to be present at and below 10 cm in all Houston Ship Channel and Galveston Bay sediments appear to be needed for enhanced microbial dioxin degradation (Fu et al. 2001 Louchouarn & Brinkmeyer (2009)).

The concentrations of contaminants in the near surface biologically active sediment zone and the associated surface waters typically determine biological uptake and the resulting ecological effects. Contaminants in these ecologically accessible media, may move between solid and aqueous phases and be remobilized from the sediment bed by sediment resuspension and porewater to surface water exchange. Once in the water column, upstream or downstream contaminant transport can occur. Partitioning between suspended solids, surface water and pore water depends on the relative chemical concentrations in each medium, organic carbon levels, reaction kinetics and the partitioning behavior of individual dioxin congener. Based on model results, the sediment sorption capacity in most areas is estimated to result in dissolved fractions less than 0.1 pg/L.

Tetrachlorinated dioxin and furan congeners may bioaccumulate in aquatic food webs and associated bird and mammal species (ATSDR 1998). More recent literature confirms that some congeners have limited potential to bioaccumulate (USEPA 2008b). The principal route of exposure is through the ingestion of contaminated food, as opposed to respiration across gill surfaces for fish or aquatic invertebrates. Certain benthic organisms accumulate dioxins from water at the water–sediment interface and through intake of phytoplankton, zooplankton, and suspended particulate materials that may contain higher concentrations of these chemicals than the surrounding water. The pathway involving benthic organisms would involve exposure of plankton to substantial sediment concentrations that could realistically partition into significant concentrations in the water column. Third party sampling results for the SJRWP Superfund Site suggest that this might only have very localized importance in the former sand dredging area between the Superfund site and the SJRF Property. Otherwise, its relevance to the CSM for the SJRF Site is considered negligible.

Finally, the bioavailability of dioxins may also be dependent on rates of sediment resuspension and remobilization (Wenning et al. 2004)

As noted above, the impoundments at the Superfund site received pulp mill wastes in the mid-1960s and are presumed to be the major source of COCs at the Superfund site. Land subsidence caused by regional groundwater withdrawal in the 1960s and 1970s contributed to the sinking of the impoundments. This resulted in the release of wastes to surface waters and the nearby surface sediment by erosion from tidal and river currents. As a consequence, contaminated material became potentially accessible to ecological receptors. Dredging activities in the area

may have aggravated the problem by facilitating the release of contaminants from the sediment medium to the water column. Determining the spatial extent of sediment contaminants from the impoundments is one issue that is being addressed in the RI/FS for the Superfund site. Given the hydrophobic nature of dioxins and furans and their affinity to be associated with sediment particles, qualitative and quantitative descriptions of hydrodynamics and sediment transport are very important because these physical processes provide the foundation for understanding chemical fate and transport processes in the Site. Physical modeling of the fate and transport of dioxins and furans in sediment is underway as part of the RI/FS process for the Superfund site and therefore is not currently available for presentation here. Hence, the degree to which ecological exposure at this stage can only be determined through sediment sampling and analysis.

At present, the known sediment concentration of dioxins and furans from the SJRWP Site will be used to describe the following preliminary physical CSM. First, the impoundments were constructed on the inside bend of a natural river oxbow, in an area historically consisting of marshlands (see Figure 1-1). This area was likely a zone of sediment accretion rather than erosion with hydrodynamic energy being directed through the main river channel along the far eastern portion of the Site (i.e., along the outside bend of the meander bow). Second, although there are significant data gaps in defining the extent of impact to sediment, a review of existing analytical data and fingerprint analysis show a decrease in sediment dioxin concentrations with distance away from the waste impoundments (Figure 2-3).

2.2 Ecological Site Conceptual Model

The ecological CSM connects the sources and transport pathways described above to ecological receptors that may be expected at the Site. The CSM facilitates evaluation of the completeness and significance of exposure to COCs in each potentially affected environmental medium. The completed exposure pathways and relevant exposure routes for fish, invertebrates and aquatic-dependent wildlife include direct contact with contaminated water or sediments; ingestion of contaminated water or sediments or prey that have been exposed to contaminated media, and respiration (for aquatic species)(Figure 2-4). The following listing summarizes the information provided in the RI/FS Work Plan for the Superfund site as it applies to the SJRF Property. Given the identification of sediment and surface water as primary environmental media of concern for the fate and transport of site-related chemicals, primary receptors would include those that are aquatic-dependent or use aquatic resources to a substantial extent. With the elimination of benthic receptors, the list of potential receptors on a general level include:

- Fish (e.g., Gulf killifish - benthic omnivore, Black drum - benthic omnivore, Southern flounder - benthic piscivore)
- Reptiles (e.g., Alligator snapping turtle – omnivore)
- Birds (e.g., Neotropic cormorant piscivorous diving waterbird, Great blue heron - wading bird, Spotted sandpiper - sediment-probing bird)
- Riparian, aquatic, and wetland habitats

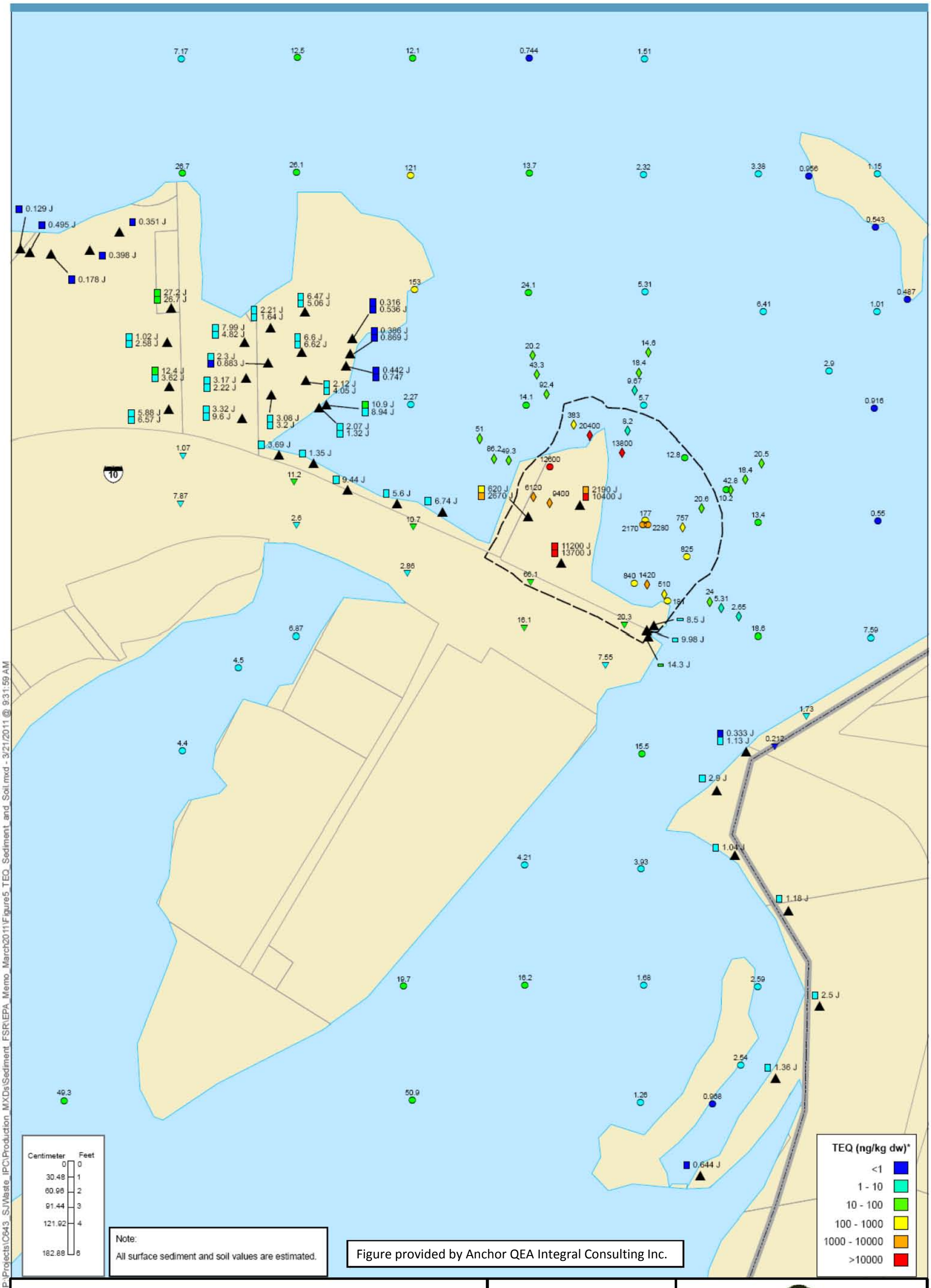

Figure provided by Anchor QEA Integral Consulting Inc.

Figure 2-3 – Third Party Sediment and Soil Sampling Results for SJRWP Superfund Site and Surrounding Areas

Tolunay-Wong Engineers, Inc.
Houston, Texas

0 500
Scale in Feet

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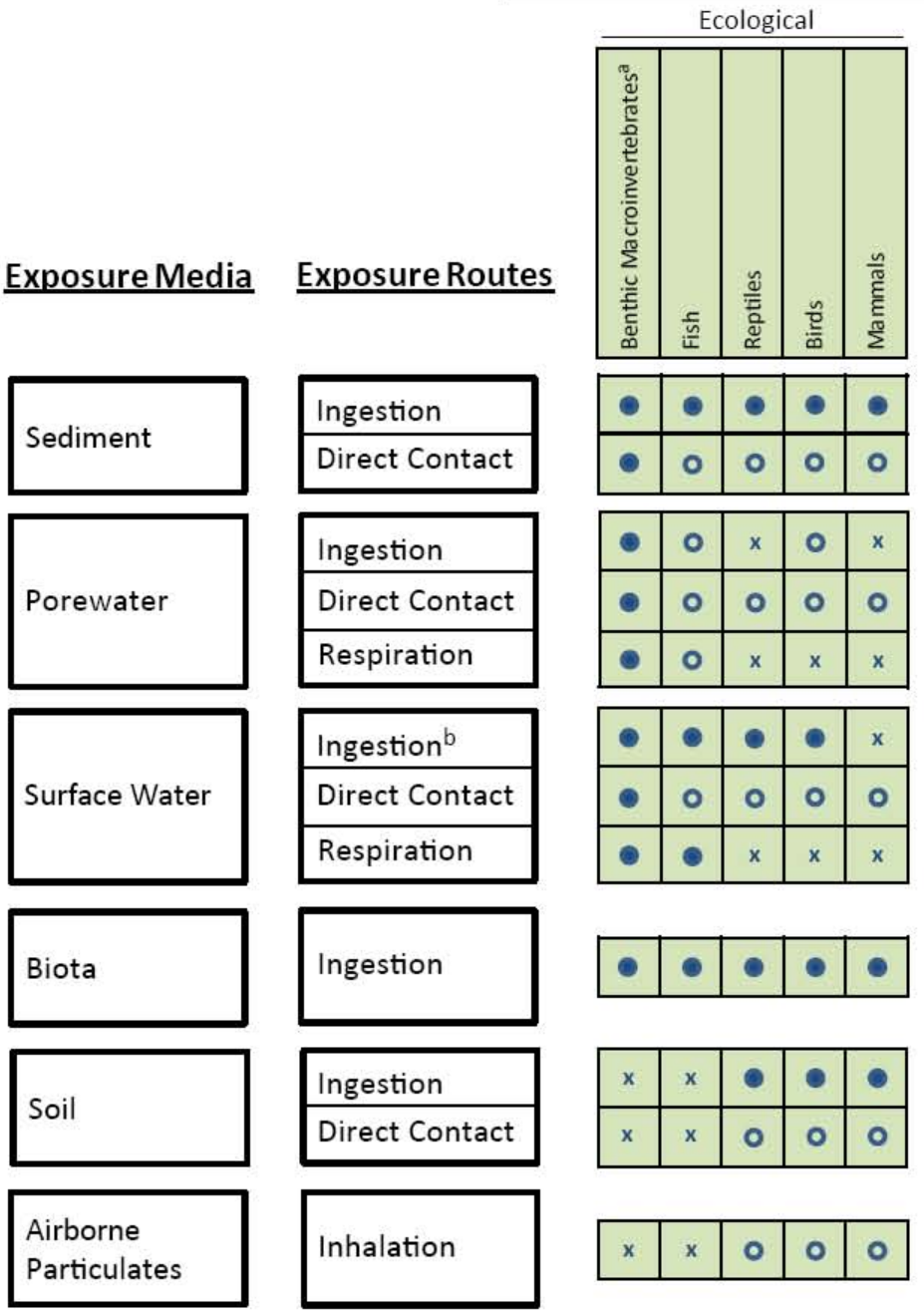
Potential Receptors of Concern



Notes:

[a]Benthic invertebrates include crabs and other crustaceans and shellfish consumed by all receptors, as well as polychaetes and other infauna consumed by fish, other marine life, birds, and mammals.

[b]Mammals and terrestrial birds are assumed not to ingest surface water for drinking, as surface water is estuarine.

From: ***Final Remedial Investigation/Feasibility Study Work Plan San Jacinto River Waste Pits Superfund Site*** (Anchor QEA, LLC, November 2010)

Figure 2-4 – Conceptual Site Model For Ecological Exposures (modified from SJRWP CSM)	**Tolunay-Wong Engineers, Inc.** Houston, Texas	Project No.: 11.12.014
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3.0 Quality Assurance Program Plan (QAPP)

As noted, this SAP draws heavily from the SAP developed for the Superfund site. Therefore, the QAPP as presented here is consistent with USEPA guidance and requirements for QAPPs (USEPA 1998, 2001).

3.1 Data Quality Objectives

Data Quality Objectives (DQOs) are a systematic approach for establishing the quality and quantity of data needed to support project decisions. The intended use of the data coupled with risks associated with the problem under consideration, establish the level of quality required by the data. A six step process has been established to develop the overall project DQOs. These include:

- An understanding of the Problem
- Identification of the project Goals
- Identification of Information Inputs
- Development of an Analytical Approach
- Specification of Performance or Acceptance Criteria
- Development of a Plan for Obtaining Data that meets these conditions.

Understanding the Problem - The problem has already been stated above as determining the potential for future barge activities to mobilize sediment that are impacted by dioxin and furans originating from the SJRWP Superfund Site. The significance of this lies in risk of direct and indirect ecological exposure to impacted sediment along the San Jacinto River and Galveston Bay into which the river empties.

Identifying the Goals of the Study - The goal of sediment sampling is two-fold. First is to establish baseline conditions for dioxin and furan concentrations in sediment where facility construction and barge activities will be conducted. Second is to monitor dioxin and furan levels in sediment to determine whether barge activities over the long term will cause or exacerbate contaminant migration along the San Jacinto River. Because of the nature of commercial activities that will take place at the SJRF Property, the problem definition is limited to potentially impacted sediment. Therefore, constituent exposure in soil on the mainland or to water in the river is not included in the study or in the establishment of DQOs.

Identifying Information Inputs - Information required to address the problem includes the evaluation of dioxin and furan concentrations in sediment to determine if they exceed the regulatory limits based on the applicable exposure pathways.

Developing the Analytical Approach - The analytical approach for this study has already been set by prior data acquisition efforts targeting the SJRWP Superfund Site. Hence, on the basis that SJRF activities are not introducing any additional contaminants and in keeping with the DQO's set for the previous studies, the analytical approach will be confined to analyzing for dioxins and furans. In order to insure that DQO's are met, the high resolution analytical method (8290A) for dioxins and furans will be used.

Specifying Performance or Acceptance Criteria - The purpose of performance and acceptance criteria is to minimize errors in data evaluation and usage. These errors, designated as Type I (false positives) and Type II (false negatives) errors result from poor or inadequate data quality which in turn can result from poor sample collection procedures yielding unrepresentative samples, sample matrix interference or poor laboratory procedures. The consequence of either type of error can be far reaching, ranging from unnecessary site cleanup costs to allowing continued exposure to chemicals of concern. For this reason, acceptance limits and performance criteria have been developed for data quality indicators. For analytical results, the project laboratory's in-house acceptance limits will be used to assess performance criteria. These are described below under Section 3.3 laboratory Quality Control. For field activities involving sample collection, prescribed sampling protocol are presented in the FSP (Section 4.0) for this project.

Developing a Plan for Obtaining Data - The plan to acquire data is largely constrained by results from previous sampling efforts targeting the SJRWP Superfund Site and the purpose for which the current study is being done. Since the current study is not attempting to establish extent, the sampling plan seeks to target locations that are representative of future activities that could disturb contaminated sediment. Based on anticipated barge activities, two types of data will be collected:

- Data that characterizes sediment at point locations where pylons will be driven.
- Data that characterizes temporal changes in dioxin concentrations along the submerged bank where barge traffic will occur.

The first type of data will characterize surface sediment where pylons will be driven. It should be noted that hollow steel tubes with $3/8^{th}$ inch wall thickness will be used as pylons, resulting in minimal disturbance of sediment. So, even if elevated levels of dioxins and furans are detected at locations where pylons will be driven, little redistribution of contaminated sediment should occur. The second type of data will characterize surface sediment that might be resuspended from currents generated by barges and tow boats.

In the absence of clearly defined screening levels for fish and wildlife, the data quality objectives for this baseline site assessment must be set conservatively low by prescribing EPA method SW-8290A for analyzing dioxins and furans using the high resolution method.

QC samples will be prepared in the field and at the laboratory to monitor the bias and precision of the sample collection and analysis procedures.

3.2 Field Quality Control

Field QC samples for this study will include a field split sample (homogenized duplicates), and an equipment blank.

The equipment blank will consist of distilled water poured over decontaminated sample preparation implements and collected in a sample container. These will be collected at a frequency of one for every 20 field samples (5%) or in the case of this study, one for the entire sampling event. Procedures for preparing field split samples and equipment blanks are presented

in Section 4.4 of the FSP. Validation criteria and procedures for field QC samples are described in Section 3.5 of this QAPP.

3.3 Laboratory Quality Control

The overall quality objective for this task is to develop and implement procedures that will ensure the collection of representative data of known and acceptable quality. The QA procedures and measurements that will be used for this project are based on USEPA guidance (USEPA 2002, 2008c).

Laboratory QC comprises a series of checks with sufficient redundancy incorporated to document data of known quality. These checks include laboratory control samples, matrix spike/matrix spike duplicates, laboratory control sample/laboratory control sample duplicates, laboratory duplicates, method blanks and surrogate spikes. The frequency of analysis for laboratory control samples, matrix spike, matrix spike duplicates, laboratory duplicates, and method blanks will be one for every 20 samples or one per extraction batch, whichever is more frequent. Surrogate spikes consisting of labeled compounds and internal standards will be added to every field sample and QC sample, as required. Instrument calibration procedures will be completed at the frequency specified in the method description.

Performance-based control limits have been established by the laboratory. These and all other control limits specified in the method description will be used by the laboratory to establish the acceptability of the data or the need for reanalysis of the samples. Laboratory control limits for recoveries of surrogate compounds, matrix spikes, and laboratory control samples, and for relative percent difference (RPD) of matrix spike duplicate pairs and laboratory duplicate pairs, are provided in each laboratory's QA manual.

A series of tools commonly used to assess the quality of environmental data are PARCC parameters (i.e., precision, accuracy or bias, representativeness, completeness, comparability).

Precision reflects the reproducibility between individual measurements of the same property. Precision will be evaluated using the results of matrix spike duplicate pairs, laboratory control sample duplicate pairs, laboratory duplicate pairs and field splits. Precision is expressed in terms of the relative percent difference (RPD) for two measurements. The following equation is used to calculate the RPD between measurements:

$$RPD = |[(C1-C2) / ((C1 + C2) / 2)]| \times 100$$

where:

RPD = relative percent difference
C1 = first measurement
C2 = second measurement

Accuracy or bias represents the degree to which a measured concentration conforms to the actual or reference value. The results for matrix spikes, laboratory control samples, field blanks, and method blanks will be reviewed to evaluate bias of the data. The following calculation is used to determine percent recovery for a matrix spike sample:

$$\%R = [(M-U) / C] \times 100$$

where:

%R = percent recovery
M = measured concentration in the spiked sample
U = measured concentration in the unspiked sample
C = concentration of the added spike

The following calculation is used to determine percent recovery for a laboratory control sample or reference material:

$$\%R = (M / C) \times 100$$

where:

%R = percent recovery
M = measured concentration in the spiked sample
C = concentration of the added spike

Results for field duplicates and method blanks can reflect systematic bias that results from contamination of samples during collection or analysis. Any analytes detected in field or method blanks will be evaluated as potential indicators of bias.

Representativeness is a qualitative QA/QC parameter. It is the degree to which data represent a characteristic of an environmental condition. In the field, representativeness will be addressed primarily in the sampling design by the selection of sampling sites and sample collection procedures. In the laboratory, representativeness will be ensured by the proper handling and storage of samples and initiation of analysis within holding times.

Completeness is a measure of the amount of valid data obtained compared to the amount expected under ideal conditions. Completeness is evaluated qualitatively and quantitatively. The qualitative evaluation is determined as a function of events contributing to the sampling event. This includes samples arriving at the laboratory intact, properly preserved, and in sufficient quantity to perform the requested analyses. The quantitative description of completeness is defined as the percentage of QC parameters that meet measurement quality objectives. QC parameters assessed for quantitative determinations of completeness include surrogate percent recoveries, MS/MSD percent recoveries and RPDs, LCS percent recoveries, field sample and duplicate RPDs, and holding times. For this project, completeness will be calculated as the ratio of usable data (i.e., unqualified data and U- or J-qualified data) to generated data, expressed as a percentage. The requirement for completeness is 90 percent for sediment.

Laboratory QC results will be evaluated to provide supplementary information regarding overall quality of the data, performance of instruments and measurement systems, and sample-specific matrix effects. The following QC samples and procedures will be performed as specified by the method:

- Instrument tuning
- Initial calibration
- Initial calibration verification

- Continuing calibration verification
- Calibration or instrument blanks
- Method blanks
- Laboratory control samples
- Internal standards
- Surrogate spikes/labeled compounds
- Matrix spikes
- Matrix spike duplicates or laboratory duplicates

Comparability is a qualitative QA/QC parameter. It is the qualitative similarity of one dataset to another (i.e., the extent to which different datasets can be combined for use). Comparability will be addressed through the use of field and laboratory methods that are consistent with methods and procedures used during the RI/FS for the SJRWP Superfund Site.

To alert the data user to possible bias or imprecision, data qualifiers will be applied to reported analyte concentrations when associated QC samples or procedures do not meet control limits. Data validation criteria and procedures are described in Section 3-4 below.

Detection Limits and Limits of Quantitation

One series of parameters in the analytical process that reflects data quality include detection limits and various quantitation and reporting limits. These include:

- Method Detection Limits (MDL)
- Sample Detection Limits (SDL)
- Method Quantitation Limits (MQL)

Method detection limits (MDL) are statistically derived limits and reflect the concentration at which an analyte can be detected in a clean matrix (e.g., sand or distilled water) with 99 percent confidence that a false positive result has not been reported. MDLs will be determined by the laboratory for each analyte, as required by USEPA (2008a). Target MDLs for this study are summarized in Table 3-1.

Method reporting limits (MRL) reflect the sensitivity of the analysis. They are established by the laboratory at levels above the MDLs and are the analyte concentrations at or above which the laboratory's precision and accuracy requirements can be routinely demonstrated and achieved. MRLs are based on the laboratory's experience analyzing environmental samples, reflecting the typical sensitivity obtained by the analytical system for environmental samples. This allows reliable quantification of concentrations to the MRL in the absence of matrix interferences. For this project, the concentration of the lowest standard in the initial calibration curve for each analysis is set as the MRL which is typically three to five times the MDL..

Table 3-1
Detection Limits and Limits of Quantitation for Dioxins and Furans In Sediment Samples

Analyte (ng/kg-dry weight) [a]	CAS Number	MDL	MQL [b]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1746-01-6	0.014	0.1
2,3,7,8-Tetrachlorodibenzofuran	51207-31-9	0.008	0.1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	40321-76-4	0.053	0.5
1,2,3,7,8-Pentachlorodibenzofuran	57117-41-6	0.029	0.5
2,3,4,7,8-Pentachlorodibenzofuran	57117-31-4	0.061	0.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	39227-28-6	0.026	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran	70648-26-9	0.030	0.5
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	57653-85-7	0.024	0.5
1,2,3,6,7,8-Hexachlorodibenzofuran	57117-44-9	0.028	0.5
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	19408-74-3	0.037	0.5
1,2,3,7,8,9-Hexachlorodibenzofuran	72918-21-9	0.045	0.5
2,3,4,6,7,8-Hexachlorodibenzofuran	60851-34-5	0.014	0.5
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	35822-46-9	0.029	0.5
1,2,3,4,6,7,8-Heptachlorodibenzofuran	67562-39-4	0.033	0.5
1,2,3,4,7,8,9-Heptachlorodibenzofuran	55673-89-7	0.038	0.5
Octachlorodibenzo--dioxin	3268-87-9	0.31	1.0
Octachlorodibenzofuran	39001-02-0	0.087	0.1
total tetrachlorinated dioxins	41903-57-5	NA	NA
total tetrachlorinated furans	30402-14-3	NA	NA
total pentachlorinated dioxins	36088-22-9	NA	NA
total pentachlorinated furans	30402-15-4	NA	NA
total hexachlorinated dioxins	34465-46-8	NA	NA
total hexachlorinated furans	55684-94-1	NA	NA
total heptachlorinated dioxins	37871-00-4	NA	NA
total heptachlorinated furans	38998-75-3	NA	NA
2,3,7,8-TCDD TEQ	NA	NA	NA

a – Based on 20g solid sample size and via soxhlet extraction
b – Based on 20g solid sample size and the level of the low calibration standard
MDL – Method Detection Limit
MQL – Method Quantitation Limit

Sample Detection Limit (SDL) is the MDL adjusted to reflect sample interferences or sample-specific adjustments, such as dilution or use of smaller aliquots sizes than prescribed in the analytical method and takes into account sample characteristics, sample preparation, and analytical adjustments.

Dioxin and furan analyte concentrations for this task will be reported to the sample specific detection limits (SDL) as described in USEPA Method 8290A (USEPA 2008a). Analytes detected at concentrations between the MRL and the SDL or MDL will be reported with a J qualifier to indicate that the value is an estimate (i.e., the analyte concentration is below the calibration range). Non-detects will be reported at the SDL for dioxins and furan congeners. The MRLs, SDLs, and MDLs will be adjusted by the laboratory, as necessary, to reflect sample dilution, percent moisture, and/or matrix interference.

All sediment samples will be reported on a dry-weight basis (i.e., corrected for percent moisture). Samples with high concentrations of target compounds that may require dilutions to bring detected levels within the range of calibration will be described in the laboratory report case narrative.

3.4 Laboratory Quality Assurance

The following responsibilities apply to the project manager and QA manager at the analytical laboratory used for this task. The laboratory project manager is responsible for the successful and timely completion of sample analyses, and for performing the following tasks:

- Ensuring that samples are received and logged in correctly, that the correct methods and modifications are used, and that data are reported within specified turnaround times.
- Reviewing analytical data to ensure that procedures were followed as required in the cited methods, laboratory standard operating procedures (SOPs) and this QAPP
- Keeping the TWE Project Manager apprised of the schedule and status of sample analyses and data package preparation.
- Notifying the TWE Project Manager if problems occur in sample receiving, analysis, or scheduling, or if control limits cannot be met.
- Taking appropriate corrective action as necessary.
- Reporting data and supporting QA information as specified in this QAPP.

The laboratory QA manager is responsible for overseeing the QA activities in the laboratory and ensuring the quality of the data for this project. Specific responsibilities include the following:

- Overseeing and implementing the laboratory's QA program
- Maintaining QA records for each laboratory production unit
- Ensuring that QA and quality control (QC) procedures are implemented as required for each method and providing oversight of QA/QC practices and procedures
- Reviewing and addressing or approving nonconformity and corrective action reports.
- Coordinating response to any QC issues that affect this project with the laboratory project manager.

3.5 Data Validation And Usability

All data generated in the field and issued by the project laboratory will be reviewed and validated prior to reporting. Data validation procedures describe the criteria for deciding to accept, reject, or qualify the data obtained and assessing the degree to which data meet specifications as described in Section 3.3. Decisions will be based on the estimate of the effect that each deviation from the QAPP will have on the usability of the associated data item, its contribution to the quality of the reduced and analyzed data, and its effect on the decision. All errors found during the verification of field data, laboratory data, and the database will be corrected prior to release of the final data.

Objective and consistent data review, evaluation, and reporting methods are essential for ensuing that data collected are of sufficient quality to meet their intended usage. A process of evaluation and validation is necessary to ensure that sample collection is conducted as planned and that the data meet project DQOs. Data verification and validation for dioxins and furans will be completed in accordance with Guidance on Environmental Data. Data validation comprises three components: the analytical laboratory's internal review of data generated, a third party verification of the date generated by the laboratory, and a review of field procedures for data acquisition.

The project laboratory is responsible for reviewing the analytical data to ensure that it meets the project requirements. The laboratory system for ensuring valid data includes reviews of the worksheets, instrument printouts, sample preparation information, calibration information, and relevant QC information. Data review is performed to assess whether there are non-conformances with the analytical method protocols or project specific requirements, and to correct problems discovered.

Third party data verification is the process of evaluating the completeness and compliance of a specific data set against the method, procedural, or contractual specifications. It essentially evaluates performance against pre-determined specifications. Data verification techniques include reviewing data and accepting, rejecting, or qualifying data on the basis established criteria. Verification and Validation will be completed according to methods described in USEPA's National Functional Guidelines for organic data review (USEPA 2005, 2008c). Data validation techniques include reviewing data and accepting, rejecting, or qualifying data on the basis established criteria. Data validation will be performed on 100 percent of the data and will include a review of the following QC parameters:

- holding times;
- sample preservation and containers;
- blanks;
- spike samples (MS/MSD and LCS);
- laboratory and field duplicates; and
- surrogate recoveries.

Data validation findings will be summarized as an appendix to the final report in the Data Usability Summary and will include the following:

- summary of QC samples (field and laboratory);
- description of qualified results; and
- completeness evaluation.

As a result of the data validation process, qualifiers may be assigned to results not meeting data quality objectives. Data qualifiers used to qualify analytical results associated with QC parameters outside data quality objectives are defined below:

- J: The analyte was positively identified; however, the result should be considered an estimated value.
- UJ: The analyte was not detected above the quantitation limit; however, the quantitation limit is considered an estimated value.
- U: The analyte was analyzed for but not detected above the detection limit.

During data evaluation, sample results that had detected results can be qualified with a "U" qualifier due to potential sample contamination from laboratory procedures, sampling equipment, sample handling or transportation to the laboratory, and the reporting limit is raised to the concentration detected in the sample.

Information from hard copy field logs will be transferred to electronic spreadsheet files and uploaded to the project database. The following checks are performed in order to prevent transcription errors:

- Data and observations entered into spreadsheets will be traceable to original data sheets through project number, date, and operator identification
- Data entry verified by second person initials of the individuals performing data entry and verification included in spreadsheet documentation

3.6 Criteria for Data Review, Verification, and Validation

Performance-based control limits established by the laboratory and control limits provided in the method protocols will be used to evaluate data quality and determine the need for data qualification. Performance-based control limits are re-established periodically by the laboratory. Control limits listed in Attachment 2 represent the current values provided by the laboratory's QA plan.

Results for field splits will be evaluated against a control limit of 50% RPD. Data will not be qualified as estimated if this control limit is exceeded, but RPD results will be tabulated, and any exceedances will be discussed in the draft report. Equipment blanks will be evaluated and data qualifiers will be applied in the same manner as method blanks, as described in the functional guidelines for data review (USEPA 2005). Data will be rejected if control limits for acceptance of data are not met, as described in USEPA (2005).

3.7 Verification and Validation Methods

Field data will be verified during preparation of samples and COC forms. Field data and COC forms will be reviewed daily by the field lead. After field data are entered into the project database, 100 percent verification of the entries will be completed by a second party to ensure

the accuracy and completeness of the database. Any discrepancies will be resolved before the final database is released for use.

Each data package generated for each analysis method will be fully validated, equivalent to a Stage 4 validation as described in USEPA (2009). If problems are encountered, the laboratory will be contacted for resolution. The accuracy and completion of the database will be verified when the EDDs are prepared and again as part of data validation. One hundred percent of entries to the database from laboratory EDDs will be checked against hard-copy data packages. In addition to verification of field and laboratory data and information, data qualifier entries into the database will be verified. Any discrepancies will be resolved before the final database is released for use.

Reporting limits for non-detects will be compared to the MRL goals to evaluate method sensitivity for each sample. Any exceedance of actual MRLs over the target MRLs will be discussed in the data report.

3.8 Reconciliation with User Requirements

Analytical results will undergo reconciliation with user requirements. The goal of data validation is to determine the quality of each data result and to identify those results that do not meet the task measurement quality objectives. Nonconforming data may be qualified as estimated (i.e., a J qualifier will be applied to the result) or rejected as unusable (i.e., an R qualifier will be applied to the result) during data validation if criteria for data quality are not met. Rejected data will not be used for any purpose. An explanation of the rejected data will be included in the draft report.

Data qualified as estimated will be used for all intended purposes and will be appropriately qualified in the final project database. However, these data are less precise or less accurate than unqualified data. Data users, in cooperation with TWE are responsible for assessing the effect of the inaccuracy or imprecision of the qualified data on data uses.

4.0 Field Sampling Plan (FSP)

This part of the SAP presents the Field Sampling Plan (FSP) prepared for the baseline site assessment at the SJRF Property located west of the SJRWP Superfund Site. As this FSP draws heavily on the FSP prepared for the Superfund site (Anchor QEA & Integral, April, 2010), it is consistent with U.S. Environmental Protection Agency (USEPA) guidance (USEPA 1988) and the agreed order between USEPA and SJRF.

The sediment sampling design incorporates two components:

- One series of samples collected at four locations where pylons will be installed for barge navigation in the docking area. While a large number of pylons will be installed, only those located in areas with the greatest risk of being impacted by dioxin and furans will be sampled. As implied by its purpose, this phase of sampling will be a single event and will require knowledge of where the pylons will be driven.

- A second series of samples collected at four locations along the submerged west bank of the main channel of the San Jacinto River where barge traffic might stir up sediment, thereby potentially remobilizing dioxin and furans. Because the objective of this sampling effort involves a time element, this part of the sampling program will be conducted annually.

The field sampling effort will be completed with a two man crew and a sampling barge prepared specifically for this task by SJRF. Samples from these eight locations will be analyzed only for dioxins and furans.

Standard Operating Procedures (SOP) for sediment sampling are included in Attachment 3.

4.1 Establishing Sample Locations

In response to concerns that barge traffic may damage the cap at the SJRWP Superfund Site SJRF has developed a conceptual layout of pylons to guide barge traffic to designated docking areas (Figure 4-1). The layout consists of four separate lines of pylons:

- a north-south line of pylons extending from the mainland harbor to the main channel of the San Jacinto River;
- an L-shaped line of pylons extending out from the east side of the mainland property for about 500 feet where it turns northeast and continues to an island adjacent to the main river channel;
- a series of four pylons extending west from the same island and along the submerged river bank; and
- a series of pylons with a rectangular configuration about 100 feet east of the same island.

Along each of these routes, Pylons are to be driven at 100 ft centers. Based on coordinates established in the Site survey by Shine and Associates, the coordinates of the pylons will be estimated by TWE in order to choose a representative group of locations for the series of four samples that will be collected as a single event.

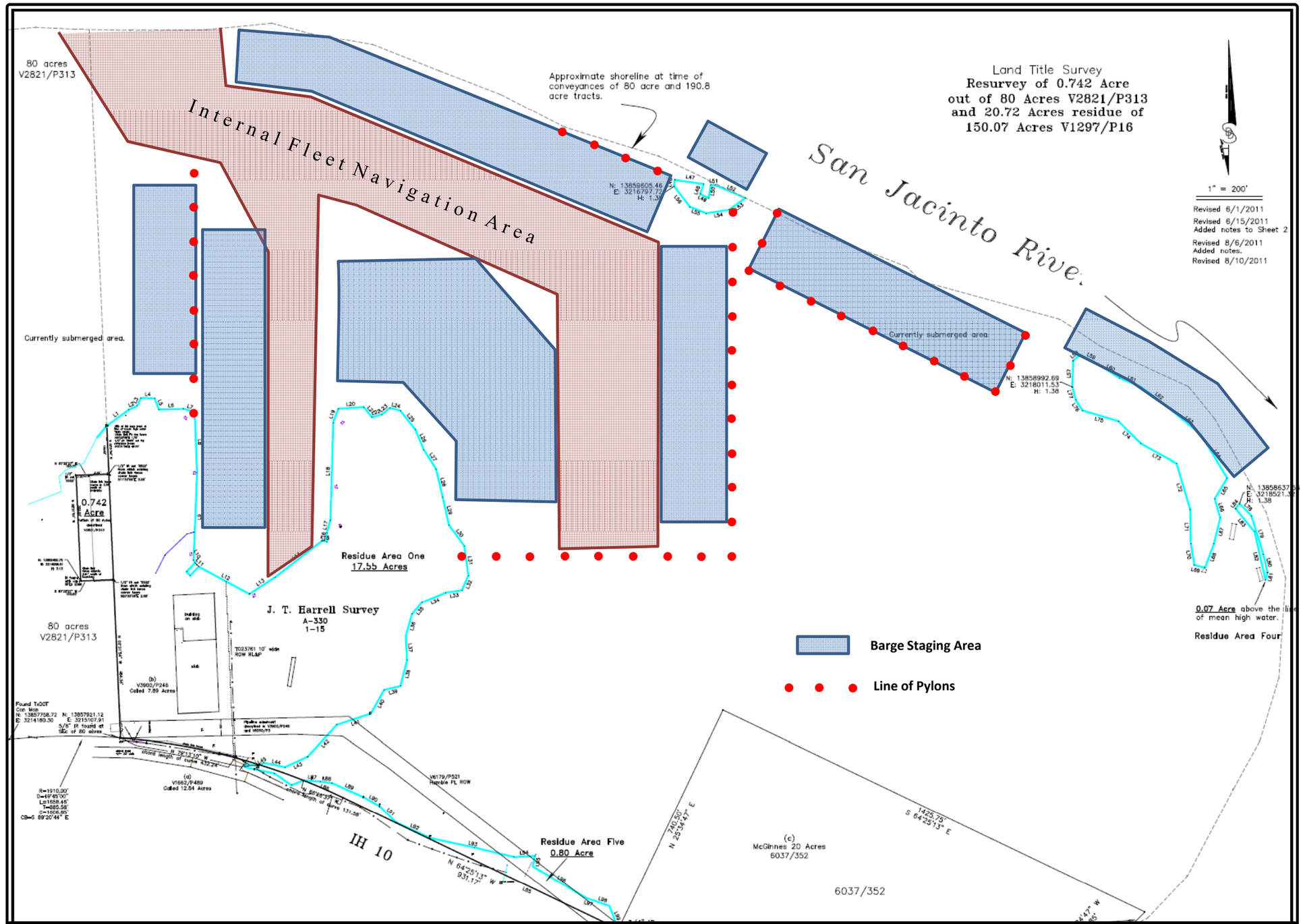

Figure 4-1 – Proposed Pylon Locations for Barge Control on SJRF Property

Project:	Work Plan For Preconstruction Site Assessment San Jacinto River Fleet Property, Harris County, Texas 18001 I-10 Channelview, Harris County, Texas

Tolunay-Wong Engineers, Inc.
Houston, Texas

0 800
Scale in Feet

Client:	San Jacinto River Fleet, LLC Channelview, Texas
Project No.:	11.12.051

Third party sampling data collected in areas of submerged land surrounding the SJRWP Superfund Site shows that the greatest potential for contamination occurs in the submerged land between the mainland area of SJRF's property and the Superfund site. TWE has chosen four locations in the former sand mining area that are representative of sediment that might exhibit impact by dioxins and furans (Figure 4-2).

In addition, four locations were chosen along the west submerged bank of the San Jacinto River for collecting baseline samples where barge traffic may stir up bottom sediment. The locations for these samples are somewhat arbitrary, requiring only that they be in the vicinity of the areas cited above. After choosing a series of four locations that will achieve the stated objective along the submerged bank, the coordinates of this initial series of sample locations will be determined using a hand held GPS unit with submeter accuracy. These coordinates will be used to re-establish sample locations for each annual event..

4.2 SAMPLING PROCEDURES

4.2.1 Sampling Vessel, Field Equipment, and Supplies

Access to river sediments will require the use of either a boat or a barge. To this end, SJRF has prepared a barge outfitted for the sampling effort.

Sampling Vessel

The sampling barge will have enough space to accommodate a the sampling team along with associated sampling equipment and a decontamination station as well as any oversight personnel from EPA, SJRF and TWE. The vessels will be piloted by an SJRF employee who will have requisite qualifications and experience for navigating the barge. Weather, river gauge height, and tides will be monitored using the following web sites:

- Weather conditions and forecasts: National Oceanic and Atmospheric Administration (NOAA) site for the Houston/Galveston area (http://www.weather.gov/forecasts/wfo/sectors/hgx.php#tabs)

- Real-time stream elevation: U.S. Geological Service (USGS) 08072050 San Jacinto River near Sheldon, 10 miles upstream from the Site (http://waterdata.usgs.gov/nwis/uv?site_no=08072050)

- Real-time data on wind direction, wind speed, and water elevation: USGS 08077637 Clear Lake Second Outflow Channel at Kemah, 22 miles south of the Site (http://waterdata.usgs.gov/nwis/uv?site_no=08077637)

- Tides: NOAA site at Battleship Texas State Park, Station Id: 8770743, 3 miles southwest of the Site (http://tidesandcurrents.noaa.gov/noaatidepredictions/viewDailyPredictions.jsp?Stationid=8770743).

Field Equipment and Supplies

Field equipment and supplies include sampling equipment, sample processing utensils, decontamination supplies, sample containers, coolers, shipping containers, log books and forms,

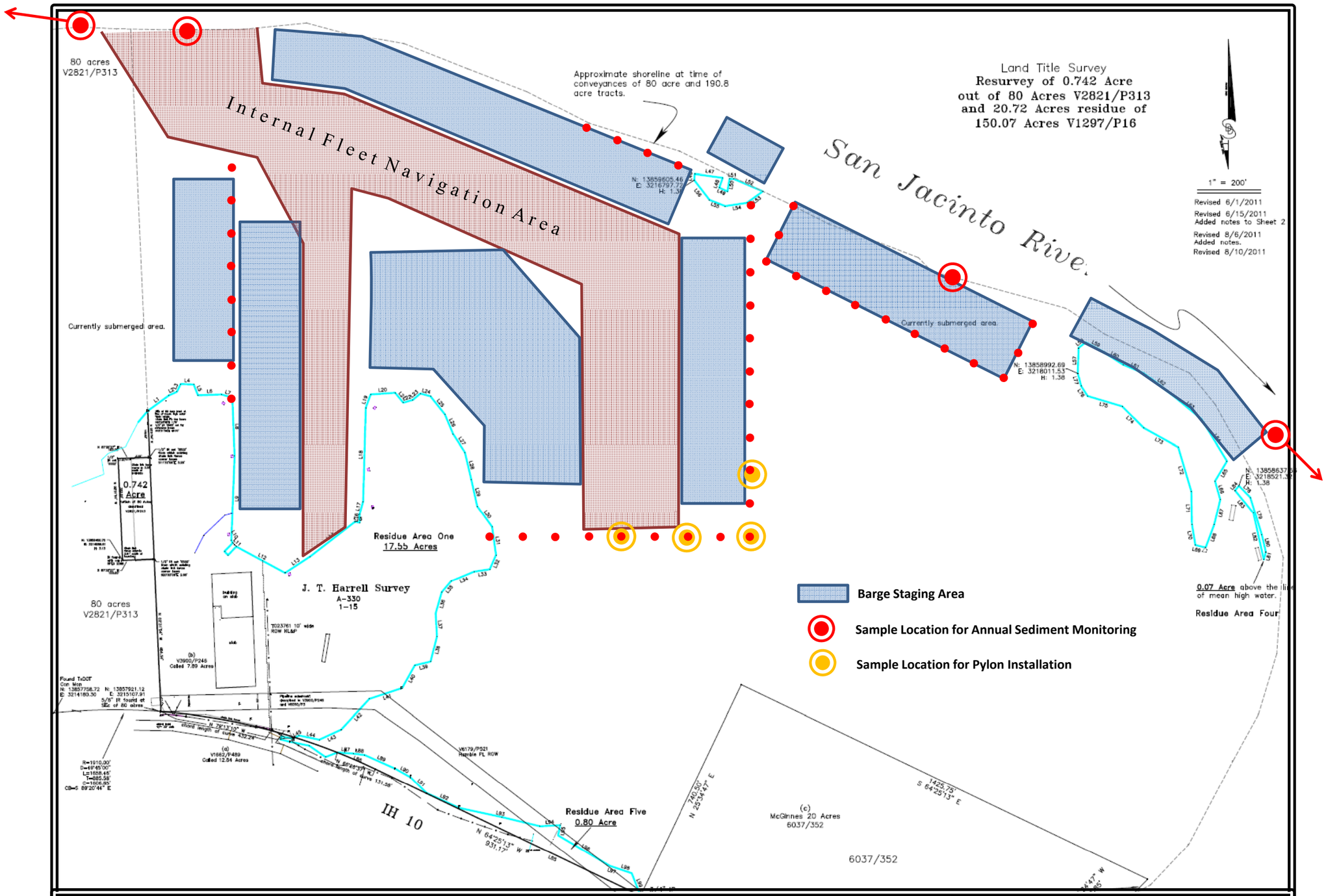

Figure 4-2 – Proposed Sediment Sampling Locations for Establishing Baseline Dioxin/Furan Concentrations in Sediment on SJRF Property

Project:	Work Plan For Preconstruction Site Assessment San Jacinto River Fleet Property, Harris County, Texas 18001 I-10 Channelview, Harris County, Texas

Tolunay-Wong Engineers, Inc.
Houston, Texas

Client:	San Jacinto River Fleet, LLC Channelview, Texas
Project No.:	11.12.051

personal protection equipment (PPE), and personal gear. PPE (e.g., gloves) is required to minimize the possibility of cross-contamination between sampling locations. Information on protective wear required for this project is provided in the HASP (Attachment 1).

The type and consistency of sediment that will be encountered may vary, requiring a variety of sampler types. Sampling equipment that will be used in the initial attempt will be either a Ekman grab sampler, Van Veen grab sampler, or a Ponar grab sampler (or equivalent type of equipment). The Ponar sampler is designed for hard bottoms and might be more appropriate in the area between the SJRF Property and the Superfund site where sand mining took place. The Ekman and Van Veen samplers are designed to sample soft sediment and might be more appropriate in areas along the submerged bank of the San Jacinto River. Failing these, other samplers that may be used include a piston sampler or a Beeker sampler, both designed for soft sediment that has the consistency of sludge. Illustrations of these samplers are provided in Attachment 4.

Sample jars, labels, chain-of-custody forms, coolers, and packaging material for the samples will be supplied by the analytical laboratory. Distilled/deionized water will be purchased from a local field equipment supplier. Sample jars will be pre-cleaned by the manufacturer and will be accompanied by bottle wash test results documenting the absence of contaminants. The laboratory will maintain a record of certification from the suppliers and the bottle shipment documentation will include batch numbers. With this documentation, jars can be traced to the supplier, and bottle-wash analysis results can be reviewed. The bottle-wash certificate documentation will be archived in TWE's project file.

Sample containers will be clearly labeled at the time of sampling. Labels will include the

- Project name,
- Client name
- Site name
- Sample number,
- Sampler's initials,
- Analyses to be performed, and
- Sample date and time.

Sample numbering and identification procedures are described in detail in Sections 4.2.4.

4.2.2 Sample Location Positioning

Prior to mobilization, preliminary latitude and longitude coordinates will be determined for preselected sample locations and established benchmark coordinates on the Site survey developed by Shine and Associates for SJRF. A hand held global positioning system (GPS) with submeter accuracy will be used to navigate to and position the sampling barge at the preselected sample locations. The standard projection that will be used during field activities is Horizontal Datum: NAD1983_StatePlane, Texas South Central, FIPS 4204, US feet. The positioning objective is to accurately determine and record the positions of all sampling locations to less than one meter resolution. If for any reason, a preselected sample location cannot be accesses or is

found to be unrepresentative for the project objectives, a new sample location will be chosen in the field and the coordinates determined with the GPS unit.

Table 4-1
Sediment Sample Coordinates

Sample Location ID	Latitude	Longitude
SJPS001-GR	TBD	TBD
SJPS002-GR	TBD	TBD
SJPS003-GR	TBD	TBD
SJPS004-GR	TBD	TBD
SJBS001-2012	TBD	TBD
SJBS002-2012	TBD	TBD
SJBS003-2012	TBD	TBD
SJBS004-2012	TBD	TBD

4.2.3. Sample Identification

In keeping with the sampling program for the SJRWP Superfund Site, each sampling station will be assigned a unique identification code based on the designation scheme for that location. Station numbers will include "SJ" to indicate San Jacinto followed by a three-letter code for the type of sample to be collected at a given location. Because the purpose for which these samples are collected deviates from that for the Superfund site, new designations have been developed to distinguish these samples from those collected specifically for the Superfund site. For samples collected at pylon locations the designation of PS (Pylon Sample) will be added and for submerged channel bank samples the designation of BS (Bank Sample) will be added. These letters will then be followed by a three-digit number (e.g., 001 through 004). For pylon sampling stations, numbers will increase toward the main channel. For sample stations along the river bank, station numbers will increase as the stations move upstream. For example, the station number for the sample location upstream of the entrance into the barge navigation channel would be SJBS004. Because the channel bank samples will be collected on an annual basis, a year date will be added to the sample designation. Hence, the sample collected at SJBS004 in 2012 will be SJBS004-2012.

Also, in keeping with the sampling scheme for the SJRWP Site, the letters GR (=grab) will be added to distinguish these from samples collected for other purposes such as geotechnical. As such, the sample cited above would be SJBS004-GR2012. Pylon sample locations will be designated at SJPS001-GR through SJPS004-GR.

Each field split sample will have a different sample number in sequence with the samples collected for that purpose. For example a sample split from SJPS002-GR will be SJPS005-GR to prevent it from being identified as a duplicate associated with another sample.

For equipment blanks, sequential numbers starting at 900 will be assigned instead of station numbers. For example, the first equipment blank for a surface sediment sample homogenized

with a stainless steel spoon and stainless steel bowl will be labeled as SDEB900S, (SD = sediment, EB = equipment blank, S = stainless steel spoon and bowl, and E = Ekman).
Details of sample labeling are provided in SOP 7 (Attachment 3).

4.2.4 Surface Sediment Sample Collection

For this project, surface sediment samples comprise the upper 6 inches (15 cm) of sediment.

One surface sediment sample will be collected at each preselected location. Any vegetative material, rocks or other objects will be removed from the sample and will be documented in the field log book. Material collected with the sampling device will be evaluated by the TWE field lead for acceptability using the following criteria:

- The sampler is not overfilled
- Overlying water is present
- The overlying water (if present) is not excessively turbid
- The sediment surface is relatively undisturbed
- An adequate penetration depth is attained (i.e., to enable sampling of the undisturbed surface sediment).

For the last criterion, a ruler will be used to ensure that adequate penetration depth has been met and that the correct amount (i.e., 6 inches [15 cm]) of sediment has been removed. If a sample fails to meet any of the above criteria, it will be rejected and discarded away from the station. After a sediment sample is judged to be acceptable, any overlying water will be siphoned off and the upper 6 inches (15 cm) of sediment will be collected in accordance with (USEPA 1997) guidelines. In the event that the grab sampler is unsuccessful in collecting an essentially undisturbed sample and an alternative sample method is used that retrieves a disturbed sample, the above acceptability criteria will be waived.

After retrieving the sediment sampler to the deck of the sampling barge, decontaminated stainless-steel spoons will be used to collect the sediment from the grab sampler. Sediment from the grab sampler will be placed into a decontaminated, stainless-steel bowl and homogenized using a stainless-steel spoon or other stainless-steel mixing implement until the sediment attains a visually uniform color and texture. The homogenized sediment sample will then be placed in pre-cleaned sample containers with Teflon-lined lids. Each sample container will be clearly labeled with the project name, site and client name, sample number, type of analysis to be performed, date and time of collection, and initials of person(s) preparing the sample. Immediately after each sample container is filled, the sample will be placed on ice (4±2°C). Sample collection and preservation requirements along with holding times for the prescribed analytical methods are specified in Table 4-2. Methods for surface sediment sample collection are provided in SOPs 1 and 2 (Attachment 3).

4.3 Equipment Decontamination

Before sampling begins at a location, the grab sampler will be scrubbed with a standard detergent (e.g., Alconox® or Liquinox®), rinsed with water (river, tap, or deionized water), air-dried, and rinsed with river water. Equipment used for compositing the sediment samples (i.e., stainless-

steel bowls and spoons) will follow the same basic decontamination sequence, except that the final rinse will be with laboratory-grade distilled/deionized water. After cleaning, the decontaminated sample homogenizing equipment will be covered with aluminum foil to protect it from windborne contamination. Any other non-dedicated sampling equipment that comes into contact with the sediment samples will be decontaminated prior to use and between samples. Non-dedicated sampling equipment will be decontaminated following procedures in SOP 3 (Attachment 3).

4.4 Field Quality Control Samples

Field QC samples will be used to assess sampling techniques and evaluate potential sources of extraneous contamination. Detailed information on overall project quality assurance and quality control (QA/QC) procedures, limits, and reporting are described in detail in the QAPP (Section 3.0). Due to the small number of samples that will be collected for the baseline site assessment, only one of each type of QC sample will be collected. If QC problems are encountered, they will be brought to the attention of the TWE project manager. Corrective actions, if appropriate, will be implemented to meet the task's data quality indicators.

Field QC samples will include field split samples (duplicates), and equipment blanks.

Field split (duplicate) samples are typically collected at a minimum frequency of 1 per 10 sediment samples. Given that eight samples will be collected for this study, one blind, field split (duplicate) sample will be collected and analyzed to assess the variability associated with sample processing and laboratory procedures. The split sample will be assigned a unique number and will not be identified as a field split to the laboratory.

Equipment blanks are typically generated at a rate of 5 percent or one in 20. As such, one equipment blank will be collected to help identify possible extraneous contamination from the sampling environment or from the sampling equipment (e.g., Ekman sampler, spoons, and bowls). All equipment blanks will be clearly noted in the field log book (e.g., sample identifier, equipment type, date and time of collection, and analysis).

4.5 Sample Packaging and Transport

Sample coolers and packing materials will be supplied by the analytical laboratory. Individual sample jars will be labeled and placed into plastic bags and sealed. Samples will then be packed in a cooler lined with a large plastic bag. Glass jars will be packed to prevent breakage and separated in the cooler by bubble wrap or other shock absorbent material. Ice in sealed plastic bags will then be placed in the cooler to maintain a temperature of approximately 4°C (±2°C). A temperature blank will be added to each cooler so the lab can document cooler temperature upon arrival at the lab. When the cooler is full, the COC form listing only the samples in the cooler will be placed into a resealable plastic bag and taped to the inside lid of the cooler. Each cooler will be sealed with two COC seals, one on the front and one on the side of the cooler. Details for sample packaging and shipping are provided in SOP 5 (Attachment 3). The shipping containers will be clearly labeled (i.e., name of project, time and date container was sealed, person sealing the cooler, and company name and address) for positive identification. These packaging and shipping procedures are in accordance with U.S. Department of Transportation regulations (49 CFR 173.6 and 49 CFR 173.24). Coolers will be transported to the laboratory by either a

member of the field sampling team, local courier, or overnight shipping service. After the samples have been received by the laboratory, they will be stored under refrigeration (4±2°C) until analyzed.

4.6 Investigation-Derived Wastes

Excess decontamination fluids and any sample remaining after processing will be disposed in the vicinity of the collection area. Dry waste (e.g., contaminated disposable boots, bibs, Tyvek™ suits, gloves, paper towels, etc) generated during the sampling event will be segregated and containerized in a 55-gallon drum and staged on the sampling barge pending receipt of analytical results. If analytical results show little or no impact by dioxins and furans, the containerized waste will be treated as common trash and disposed accordingly.

4.7 Field Documentation

The integrity of each sample from the time of collection to the point of data reporting will be maintained through proper record-keeping and COC procedures that allow samples to be traced from collection to final disposition. Representative photographs will be taken at each sample location to provide an area context where samples are collected. Additionally, a photograph will be taken of each sediment sample as observed when it arrives on deck. Details of field documentation are provided in SOP 6 (Attachment 3).

4.7.1 Field Log Book

All field activities and observations will be noted in a log book. Information will include sampling personnel, date, time, station designation, and general observations. Any changes that occur during sampling (e.g., personnel, responsibilities, or deviations from the FSP) and the reasons for these changes will be documented. The log book will identify on-site visitors (if any) and the number of photographs taken at each sampling location. The field lead is responsible for ensuring that all relevant information is entered into the field log book and that all data entries are accurate. Requirements for log books include the following:

- Log books will be bound, with consecutively numbered pages.
- Removal of any pages, even if illegible, will be prohibited.
- Entries will be made legibly with black (or dark) waterproof ink.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the date and time that the notation is made should be recorded, as well as the time of the observation itself).
- Each consecutive day's first entry will be made on a new, blank page.
- The date and time, based on a 24-hour clock (e.g., 0900 for 9:00 a.m. and 2100 for 9:00 p.m.), will appear on each page.
- The bottom of the page must be signed and dated by the individual who makes the last entry.

If more than one individual makes entries on the same page, each recorder must initial their entry. Log book corrections will be made by drawing a single line through the original entry, allowing the original entry to be read. The corrected entry will be written alongside the original.

Corrections will be initialed and dated and may require a footnote for explanation. The type of information that may be included in the field log book includes the following:

- Project name, site location, and project number
- Client name;
- Project start date and end date;
- Weather conditions;
- Name of person making entries and other field staff present;
- On-site visitors, if any;
- Sampling vessel;
- Station number and location;
- The sample number for each sample to be submitted for laboratory analysis;
- The specific date and time and sampling location coordinates derived from GPS associated with eachstation number;
- The sample number, date and time of collection, and equipment type;
- Observations made during sample collection, including weather conditions complications, and other details associated with the sampling effort;
- Sample description (appearance, color, presence of foreign material, biological structures, other debris, oil sheens, and odor);
- Sediment penetration depth (nearest 0.5 cm) based on thickness of sediment in sampler
- Any visible obstructions or objects near any of the sampling locations, e.g.,• vegetation, discarded heavy trash, etc;
- The number of photographs taken at the sampling location;
- A record of Site health and safety meetings, updates, and related monitoring, and;
- Any deviation from the FSP and reasons for deviation.

In addition, a sampling location map will be updated during sampling and will be maintained throughout the sampling event. Any changes in sample locations will be shown on the sample location map and the new coordinates recorded in the logbook. All log book entries must be completed at the time that any observations are made. Copies of all log books and forms will be retained by in the TWE office.

4.7.2 Chain-of-Custody Procedures

Samples are in custody if they are in the custodian's view, stored in a secure place with restricted access, or placed in a container secured with custody seals (see SOP 4). A COC record will be signed by each person who has custody of the samples and will accompany the samples at all times. Copies of the COC will be included in laboratory and QA/QC reports. Attachment 5 contains an example of the COC form that will be used during the baseline site assessment. At a minimum, the form will include the following information:

- Site name;
- Project number;
- Client name;
- Field lead's name;
- Collection date and time for each sample;

- Sample type (i.e., soil);
- Requested analyses;
- Sample preservation information (if any);
- Turnaround time;
- Type or level of data package; and,
- Name of the carrier relinquishing the samples to the transporter, noting date and time of transfer and the designated sample custodian at the receiving facility.

TWE's field lead will be the designated field sample custodian and will be responsible for all sample tracking and COC procedures until relinquished to the laboratory. The field sample custodian will be responsible for final sample inventory and will maintain sample custody documentation. The field sample custodian will complete COC forms prior to removing samples from the field. Upon transferring samples to the laboratory by the sample custodian (if samples are transported by the field team) or shipping courier (as appropriate), the field sample custodian will sign, date, and note the time of transfer on the COC form. The original COC form will be transported with the samples to the laboratories while the last copy will be retained by the field lead. All samples will be shipped to the testing laboratory in coolers sealed with custody seals.

The laboratory will designate a sample custodian who will be responsible for receiving samples and documenting their progress through the laboratory analytical process. The sample custodian for the laboratory will note the integrity of the custody seals upon receipt of samples at the laboratory. The laboratory sample custodian will also ensure that the COC and sample tracking forms are properly completed, signed, and initialed when logging in the samples. When the laboratory receives the samples, the laboratory sample custodian will conduct an inventory by comparing sample labels to those on the COC form. The custodian will enter the sample number into a laboratory tracking system. The custodian will assign a unique laboratory number to each sample and will be responsible for distributing the samples to the appropriate analyst or for storing samples at the correct temperature in an appropriate secure area.

4.8 Field Data Management And Reporting Procedures

During field operations, effective data management will be practiced in order to provide consistent, accurate, and defensible data and data products. Daily field records (a combination of field log books and COC forms) will make up the main documentation for field activities. Upon completion of sampling activities, field notes and COC forms will be scanned to create an electronic record.

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ATTACHMENT 1

HEALTH AND SAFETY PLAN

SEDIMENT SAMPLING HEALTH AND SAFETY PLAN

Prepared for
San Jacinto River Fleet, L.L.C.
P.O. Box 878
Sugar Land, TX 77487

Prepared by
TWE Inc.
10710 S. Sam Houston Pkwy W., Suite 100
Houston, Tx 77031

February 2012

HEALTH AND SAFETY PLAN ACKNOWLEDGEMENT FORM

Project Name: San Jacinto River Fleet Property

This HASP is approved by TWE for use at the San Jacinto River Fleet Property. It presents the minimum health and safety standard for the Site and will be strictly enforced for TWE personnel and other consulting personnel including subcontractors where applicable.

I have reviewed the HASP for the 2012 sediment study and have had an opportunity to ask any questions I may have and have been provided with satisfactory responses. I understand the purpose of the plan, and I consent to adhere to its policies, procedures, and guidelines while an employee of TWE, or its subcontractors.

Date	Name (print)	Signature	Company

SITE EMERGENCY PROCEDURES

Emergency Contact Information

Table A
Site Emergency Form and Emergency Phone Numbers

Category	Information	
Chemicals of Potential Concern	Dioxins/Furans, aluminum, magnesium, mercury, and copper	
Minimum Level of Protection	Level D	
Site(s) Location Address	18001 East Fwy, Channelview, TX 77530	
Emergency Phone Numbers		
Ambulance	911	
Fire	911	
Police	911	
Poison Control	911 and then 1-800-222-1212 if appropriate	
Project-Specific Health and Safety Officers' Phone Numbers		
TWE Field Lead (FL) &Site Safety Officer (SSO)	TBD	Office: (713) 722-7064
TWE Corporate Health and Safety Manager (CHSM)	Paul Wild	Office: (713) 722-7064 Cell: (281) 844-3747
TWE Project Manager (PM)	Mark Brotherton	Office: (713) 722-7064 Cell: (713) 302-6717
Client Contact – San Jacinto River Fleet	Brian Darnell	Office 281-452-2222 Office Direct 281-860-2163
Reporting Oil and Chemical Spills		
National Response Center	1-800-424-8802	
State Emergency Response System	(512) 424-2138	
EPA Environmental Response Team	(201) 321-6600	

Note: In the event of any emergency, contact the TWE PM and FL.

Figure A
Site Location Map

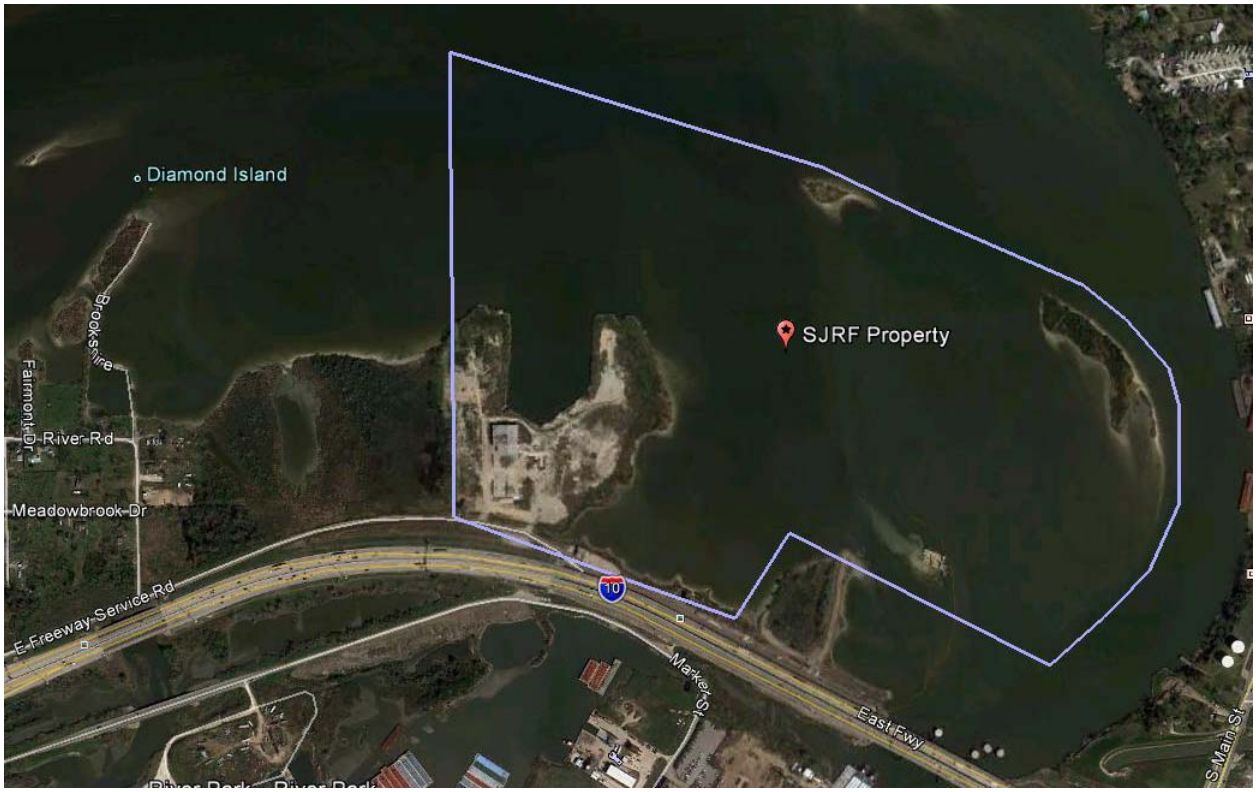


Table B
Hospital Information

Category	Information
Hospital Name	Triumph Hospital – East Houston
Address	15101 East Freeway
City, State	Channelview, TX 77530-41041
Phone	(713) 691-6556
Emergency Phone	(713) 691-6556

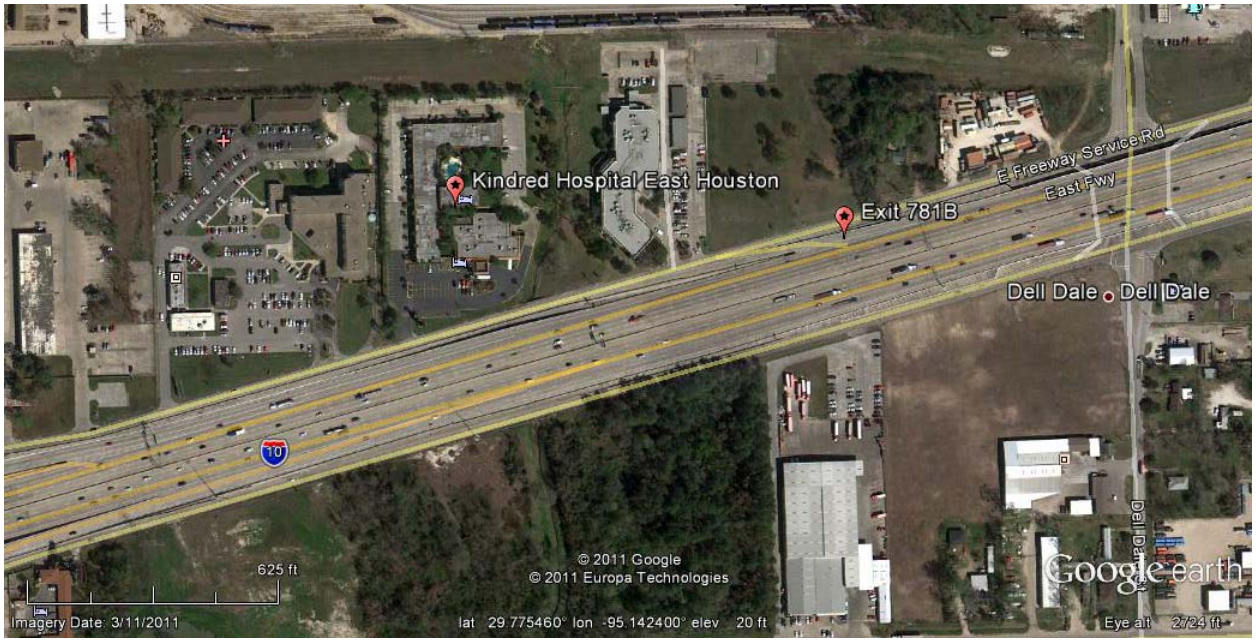
Figure B
Hospital Route Map

DRIVING DIRECTIONS FROM SITE TO HOSPITAL

1. Head west on East Freeway Service Road toward Monmouth Street (approximately 0.9 mile).
2. Take the ramp on the left to I-10 West.
3. Proceed on I-10 West to Exit 781B (approximately 3.7 miles).
4. Exit freeway at Exit 781B onto East Freeway Service Road.
5. Continue heading west on East Freeway Service Road (approximately 0.2 mile).
6. Kindred Hospital East Houston will be on the right (total distance approximately 5 miles).

Figure C
Access from Site to I-10 West

Figure D
Hospital Detail (Egress from I-10 West)



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LIST OF ACRONYMS AND ABBREVIATIONS

Abbreviation	Definition
°F	degrees Fahrenheit
ACGIH	American Conference of Governmental Industrial Hygienists
AWG	American Wire Gauge
CHSM	Corporate Health and Safety Manager
COPC	chemical of potential concern
CRZ	contamination reduction zone
FL	Field Lead
HASP	Health and Safety Plan
TWE	Tolunay Wong Engineers, Inc.
IPC	International Paper Company
JHA	Job Hazard Analysis
mg/m^3	milligrams per cubic meter
MSDS	Material Safety Data Sheets
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Act or Administration
PEL	Permissible Exposure Limit
PFD	personal flotation device
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
SJRF	San Jacinto River Fleet Property
SJRWP	San Jacinto River Waste Pits Superfund Site
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
TLV	Threshold Limit Values
TWA	Time Weighted Average
USEPA	U.S. Environmental Protection Agency

1 INTRODUCTION

Tolunay-Wong Engineers, Inc (TWE) has prepared this Health and Safety Plan (HASP) to protect workers from potential hazards during sediment sampling activities at locations within the San Jacinto River. The provisions of this Sediment Sampling HASP are mandatory for all TWE personnel assigned to the project. Other contractors, if any, that will be working at the Site are also expected to follow the provisions of this Sediment Sampling HASP unless they have their own HASP that covers their specific activities related to this study and such HASPs have been approved by TWE. Any other contractor HASPs must include the requirements set forth in this Sediment Sampling HASP. At a minimum, all visitors to the work Site, including U.S. Environmental Protection Agency (USEPA) personnel; state and local government personnel; or employees, representatives, or contractors of San Jacinto River Fleet (SJRF) must also abide by the requirements of this Sediment Sampling HASP and will attend a pre-work briefing where the contents of this Sediment Sampling HASP will be presented and discussed.

It is TWE's policy to provide a safe and healthful work environment. No aspect of the work is more important than protecting the health and safety of all workers. TWE cannot guarantee the health or safety of any person entering the Site. Because of the potential hazards that may be encountered at the Site and the activity occurring thereon, it is not possible to regulate personal diligence or to discover, evaluate, and provide protection for all possible hazards that may be encountered. Strict adherence to the health and safety guidelines set forth herein will reduce, but not eliminate, the potential for injury and illness at the Site. The health and safety guidelines in this plan were prepared specifically for the Site and should not be used on any other site without prior evaluation by trained health and safety personnel.

A copy of this Sediment Sampling HASP must be in the custody of the field crew during field activities. All individuals performing field work must read, understand, and comply with these plans before undertaking field activities. Once the information has been read and understood, the individual must sign the Site Health and Safety Acknowledgment Form provided with this Sediment Sampling HASP. The signed form will become part of TWE project files.

This Sediment Sampling HASP, may be modified at any time based on the judgment of TWE's Site Safety Officer (SSO) in consultation with TWE's Corporate Health and Safety Manager (CHSM) and Project Manager or designee. Any modification will be presented to the on-site team during a safety briefing and will be recorded in the field notebook.

2 SCOPE OF WORK

To perform the field work required for the 2012 sediment study, one field sampling team will be deployed to collect surface sediment for chemical analyses within the San Jacinto River. One series of samples will be collected along the submerged bank of the San Jacinto River at the SJRF Property boundary and a second series of samples will be collected in the area between the mainland part of the SJRF property and the SJRWP Superfund Site. Samples will be analyzed for dioxins and furans.

The TWE team will collect submerged surface sediments near the the San Jacinto River from a barge using either an Ekman grab sampler, a van Veen grab sampler or a Ponar grab sampler.(or

equivalent kind of equipment). Access to all of the stations will require the use of a barge provided by SJRF.

3 AUTHORITY AND RESPONSIBILITIES OF KEY PERSONNEL

This section describes the authority and responsibilities of key TWE project personnel. All TWE personnel working on this project are current with their OSHA mandated 40 hr HAZWOPER safety training and the follow-up annual refresher. In addition, all TWE Site personnel have their Transportation Worker Identification Credential (TWIC) card.

Site personnel will consist of a two man crew that includes the Field Lead and a helper. The Field Lead will also assume the duties of the Site Safety Officer (SSO). The SSO has the authority to enforce the rules of the Sediment Sampling HASP to any individual present at the Site, whether that individual is an employee or an outside contractor who is working with his or her team. He also has the authority to discontinue or modify Site operations when unsafe conditions are detected.

Occupational Safety and Health Act or Administration (OSHA) (OSHA 1997) considers it essential that on-site personnel have a clear understanding of health and safety expectations, lines of authority, and emergency response actions. The names and contact information for key safety personnel are listed in Table A: Emergency Site Procedures. Should key Site personnel change during the course of the project, a new list will be established and given immediately to the field teams. The emergency phone number for the Site is 911, and should be used for all medical, fire, and police emergencies.

The SSO will be in direct contact with the TWE Project Manager to ensure that appropriate health and safety procedures are implemented during the sediment study.

Client personnel that will provide a barge for in-water work will be identified at a later date, and their names and contact information will be distributed with an updated contact list table to all participants.

4 JOB HAZARD ANALYSIS

The OSHA standard (29 CFR 1910.120) mandates that Site safety and health programs require that task and operation-specific hazard analyses be conducted at the Site. These analyses are intended to ensure a comprehensive and systematic approach to hazard anticipation, recognition, and evaluation at hazardous waste sites. The kinds of potential hazards associated with sediment sampling are summarized in the Job Hazard Analysis (JHA) that is provided in Table 1 (attached) for the sediment sampling task. The JHA lists specific tasks or operations required during Site activity and the locations where these tasks or operation are performed. A single JHA may be used for a task performed in multiple locations if the hazards, potential exposures, and controls are the same in each location. The JHA lists the chemical hazards associated with that task and their known or anticipated airborne concentrations during performance of the task. Each JHA also identifies anticipated physical and biological hazards and potential exposure levels or the likelihood of exposure. The final section of each JHA lists the control measures

Table 1
Job Hazard Analysis for Sediment Sampling
Baseline Site Assessment

Chemical Hazards						
Chemical of Potential Concern	PEL - TWA1 mg/m3	TLV - TWA2 mg/m3	STEL mg/ m3	Ceiling Limit mg/m3	Exposure Routes	Symptoms
2,3,7,8-TCDD	-	-	-	-	Inh, Abs, Ing, Con	Irritation to eyes, chloracne, dermatitis

Physical Hazards			
Name of Physical Hazard	Source	Exposure Level/ Potential	Exposure Limit
Barging operations	Barge deck	Likely	N/A
Pinch and crush zones	Barge winch and crane	Likely	N/A
Drowning	Barge	Likely	N/A
Heat (ambient)	Sun	Likely	N/A
Cold weather operations	Barge deck area	Likely	N/A
Oxidizers – storage and use	Decontamination solution	Likely	N/A
Slips/trips/falls/person overboard	Barge deck area	Likely	N/A
Inclement weather – rain, wind	Barge deck area	Likely	N/A
Sharp objects – broken glass	Barge deck	Likely	N/A
Corrosives -storage and use	Decontamination solution	Likely	N/A
Flammable liquids – storage and use	Decontamination solution	Likely	N/A
Material handling	Sediment	Likely	N/A
Vehicular travel	Van shuttle	Likely	N/A
Working over water	Barge deck area	Likely	N/A

Biological Hazards			
Name of Biological Hazard	Source	Exposure Level/Potential	Exposure Limit
Ragweed	Beach area	Likely	N/A
Insect bites and stings	Barge and beach area	Likely	N/A
Control Measures Used			

Engineering Controls: see the FSP (Appendix A of this document). In addition: 1. Anchor weights of sampling Barge are such that the use of the Barge's winch should be employed. 2. Weights of coolers are such that two persons should lift the units to prevent back injuries. 3. To avoid insect bites, insect repellents may be applied. 4. Field staff must bring allergy medications if allergic to ragweed. 6. To mitigate poisoning from a snake bite, a snake bite kit will be available on Site.	
Level of PPE: D	PPE Equipment: Chemical-resistant steel-toed boots, Tyvek™ overalls, splash-proof safety goggles, nitrile gloves, hardhat, PFD Type III.
Location: On Barge deck	
Work Practices:	Change disposable nitrile gloves frequently. Wash hands and face with soap and water after each sampling event. Take shower at end of workday.

Notes:
1 PEL-TWA values from NIOSH Pocket Guide to Chemical Hazards (1997).
2 TLV-TWA values from American Conference of Governmental Industrial Hygienists (ACGIH1996).
3 PEL and TLV values for coal tar pitch volatiles include anthracene, benzo(a)pyrene, chrysene, and pyrene.
*Naphthalene: 50 mg/m3 = 10 ppm (NIOSH 1997).
Inh = Inhalation, Abs = Absorption, Con = Contact, Ing = Ingestion
NA = Not applicable.
NE = Not established.

implemented to protect employees from exposure to the identified hazards. The information provided here is designed to satisfy OSHA's hazardous waste operations and emergency response JHA requirements of 1910.120(b)(4)(ii)(A) and the workplace hazard assessment requirements of 1910.132(d).

TWE's SSO will modify the study-specific JHA when:

- The scope of work is changed by adding, eliminating, or modifying tasks
- New methods of performing study tasks are selected
- Observation of the performance of study tasks results in a revised characterization of the hazards
- New chemical, biological, or physical hazards are identified
- Exposure data indicate changes in the concentration and/or likelihood of exposure
- New/different control measures are selected.

If the JHA is modified, then related provisions in other sections of this Sediment Sampling HASP will also be modified as needed. The overall hazard level associated with the activities described in Section 2 is low. Hazards encountered during these sampling programs are due to physical safety hazards associated with the field operations, exposure to chemicals used to decontaminate sampling gear and preserve samples, and potential exposure to hazardous materials present within the sediments. Potential hazards while working at the Site include, but are not limited to, the following:

- Exposure to toxic and/or hazardous chemicals
- Physical hazards from use of sampling equipment and operations on a vessel and on land areas

- Physical hazards from working conditions (e.g., hypothermia, slips/trips/falls, or drowning).

As described below, protective equipment and safe working procedures will help prevent accidents caused by these hazards. All workers are required to use the buddy system, and no one will be allowed to work alone.

4.1 Definitions

Chemical hazards are defined by the following terms:

Time-weighted Average (TWA): The recommended exposure limits for a hazardous chemical in the workplace, typically during an 8-hour work day over a 40-hour work week. TWAs are recommended by the National Institute for Occupational Safety and Health (NIOSH) under the authority of OSHA.

Permissible Exposure Limit (PEL): The legal maximum air concentration of a hazardous chemical to which workers may be exposed on an 8-hour basis as established by OSHA. The PEL is a time-weighted average value (PEL-TWA), and for all chemicals discussed below, the corresponding PEL-TWA is the same for OSHA.

Threshold Limit Value (TLV): The recommended maximum air concentration of a hazardous chemical to which workers may be exposed on an 8-hour basis. TLVs are time weighted average values (TLV-TWA) and are recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).

Short-term Exposure Limit (STEL): A 15-minute TWA exposure that should not be exceeded at any time during a workday.

Ceiling Limit: Employee exposure which should not be exceeded during any part of the workday.

Buddy system: A system in which an employee is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

4.2 Chemical Hazards

Table 1 presents a summary of health-based chemical exposure information for the primary COPCs for the sediment sampling.

4.2.1 Potential Hazards of COPCs in Sediments

A summary of the COPCs for health and safety and their concentrations in the Site sediments is provided in Table 1. This list includes chemicals that were detected in surface sediment samples: dioxins/furans, aluminum, copper, and mercury. During the sediment sampling, these COPCs will be bound in a wet solid matrix (i.e., the sediment) and pose a low risk for inhalation. Personnel will also be working in an open-air environment. Nonetheless, these compounds are potentially hazardous and exposure by all routes should be minimized. There is no evidence of

significant concentrations of volatile chemicals in sediment or surface water. Therefore, respiratory protection is not expected to be needed, and either Level D (off-site sampling handling) or Modified Level D personal protective equipment (PPE) should be appropriate for the entire investigation.

4.3 Physical Hazards

As stated in Section 2 above, it will be necessary to use a barge to access the proposed sediment sampling locations. The sections below provide safety guidelines for the use of barges and the different physical hazard that may be associated with each of these operations is discussed below.

4.3.1 Sampling Vessel Operations

The physical hazards associated with the deployment and retrieval of sampling equipment result from their weight and the method of deployment. Only appropriate personnel whose presence is required will be deploying and retrieving sampling gear. Under circumstances of potentially dangerous waves or winds, the barge operator and SSO will employ best professional judgment to ensure safe field operations.

To avoid injuries from heavy equipment, personnel will wear steel-toed boots when working on the work deck or loading/unloading heavy equipment from the vessel. Due to the proximity of overhead gear, hard hats will be worn when personnel are present on the work deck. Sample handling equipment, containers, deck lines, hydraulic cables, and water hoses not in immediate use will be kept clear of walkways and work areas until needed. Each time operations at a given location have been completed, excess sediment on the deck will be washed overboard to prevent slipping, minimize personnel exposure to potentially contaminated sediment, and limit cross-contamination between sample locations. PFDs (i.e., life vests) will be provided for and worn by all personnel working on the deck, or as directed by the SSO or vessel operator. The vessel will also be equipped with throwable life rings, fire extinguishers, and warning horns, and each crew member will be briefed on their storage location.

4.3.2 Man Overboard

While any team is working over water on the sampling vessel there is a potential for a man overboard situation. The danger of this situation is increased if the water is flowing swiftly or if there is debris in the water. All personnel working over water will wear a PFD. If a man-overboard situation occurs, all vessel engines will be stopped immediately. Flotation devices (e.g., life rings) attached to lines will be thrown to the victim from the vessel. The victim will then be brought aboard the sampling vessel; wet clothes will be removed and replaced with dry clothing. The victim may need to be treated for cold stress (Section 4.3.5). No other person should enter the water unless the victim is unconscious or seriously injured. If required, rescuers must wear PFDs, and be tethered to the sampling vessel or shore.

4.3.3 Motor Vehicle Operation

Motor vehicles will be used to transport field personnel, equipment, and supplies to the sampling vessels and sample processing/shipping locations. Only sampling team personnel with valid driver's licenses and liability insurance (per local state laws) will operate motor vehicles required

for work activities. All field staff will use best professional judgment at all times to ensure safe operation of motor vehicles, including:

- Operators are to practice defensive driving and drive in a courteous manner
- Operators are to be aware of pedestrians and give them the right-of-way
- All vehicles are to be operated in a safe manner and in compliance with statutory traffic regulations and ordinances
- Operators are to verify that safety seat belts are in proper operating order
- Seat belts are to be worn by the driver and all passengers whenever the vehicle is in motion
- No persons are allowed to ride in the back of any vehicles, unless equipped with seat belts
- Vehicles are to be driven in conformance with local speed limits
- Operators are to avoid excessively long driving periods
- Personnel who are impaired by fatigue, illness, alcohol, illegal or prescription drugs, or who are otherwise physically unfit, are not allowed to drive
- Personnel are to avoid using cellular phones or engaging in other distractions while driving
- Motor vehicle accidents are to be reported to the responsible law enforcement agency, TWE's human resources manager, and TWE's CHSM.

4.3.4 Physical Exposure

Exposure to the elements and fatigue are two major causes of accidents while working outside. The individual task activities may include long work days and unpredictable weather. Working in cold, rough, or swift-moving waters can lead to fatigue, seasickness, and/or overexposure. The combination of vessel motion and fatigue increases the risk for a man-overboard situation. To prevent fatigue and overexposure in adverse weather conditions, field personnel will take regular work breaks. Extra clothing will be brought to accommodate changes in weather. Cold stress can be manifested as hypothermia (discussed further in Section 12.2.2 of the overall HASP; Anchor QEA 2009). Heat-related illnesses can occur at any time when protective clothing is worn. When air temperatures average 70 to 75°F, the risk of heat related illnesses increases. Heat stress can be manifested as both heat stroke and heat.

Personnel should monitor their own conditions and capabilities and are responsible for taking appropriate measures to relieve fatigue, exposure, or heat stress. Because fatigue and extreme heat/cold stress may impair an individual's judgment, the SSO is also responsible for monitoring workers' apparent condition in relation to physical exposure. The SSO and vessel operator may direct any crew member to cease working if conditions indicate the potential for overexposure or if overexposure.

4.3.5 Other Physical Hazards

Incorporating the following basic safety procedures can prevent many of the most common causes of injury or accident during field sampling:

- Implement good housekeeping practices, including immediate cleanup of spills and safe storage of all materials. All equipment or materials not in current use will be removed from the immediate work area.
- Use proper lifting and moving techniques to prevent back or muscle strain or injury. Any heavy equipment, boxes, coolers, or other items should be tested before lifting. If a piece of equipment is too heavy, the equipment should be broken into smaller components or assistance requested. Lifting should be done with the legs, not the back.
- Use extra caution when handling sharp tools or sampling devices and when possible, wear protective gloves.
- Use hearing protection when working with or near a power generator, and when using a circular saw to cut sediment cores.
- Use the following safety procedures when employing extension cords:
    - Always inspect cords before using them. Use only cords in good condition to avoid electrical shocks.
    - Extension cords used in wet and/or outdoor locations have to be protected by ground fault circuit interrupters.
    - Extension cords should be a minimum of 16 American Wire Gauge size (AWG) and be rated for the equipment in use. Example: To connect an impact corer to a 2000-watt power generator, a 12 AWG (25 amps) extension cord is needed to carry the necessary current to start up the unit.
    - Avoid running extension cords across walkways. Instead, run them overhead if possible and place flagging tape on the extension cord to warn of possible overhead hazard.
    - An extension cord that is hot to the touch is overloaded and should be replaced.

4.4 Employee Notification of Hazards and Overall Site Information Program

The information in the JHA will be made available to all employees who could be affected by it prior to the time they begin their work activities. Modifications to JHAs and the accompanying data sheets will be communicated during routine briefings. Consistent with paragraph 1910.120 (i) of Hazardous Waste Operations and Emergency Response (HAZWOPR) (OSHA 1994), the SSO will also inform other contractors and subcontractors working on this study about the nature and level of hazardous substances at the Site, the likely degree of exposure to workers who participate in Site operations, and any modifications to this Sediment Sampling HASP to other contractors and subcontractors working on this Site. Daily safety briefings will take place before work begins. The daily briefing form provided in Exhibit 1 will be used to record the daily meetings.

5 SITE CONTROL ZONES

The use of Site control zones is designed to reduce the spread of hazardous substances from contaminated areas to clean areas, to identify and isolate contaminated areas of the Site, to facilitate emergency evacuation and medical care, to prevent unauthorized entry to the Site, and to deter vandalism and theft.

5.1 Sediment Sampling

5.1.1 Exclusion Zone

Exclusion zones will be established wherever exposed sediment is handled:
On a sampling vessel, the exclusion zone includes the area of the vessel in which sediments collected from the river bottom are handled. This part of the vessel is designated as the exclusion zone only when sediment samples are being handled on the vessel. The exclusion zone boundaries will be marked with orange traffic safety cones, or equivalent. A designated member of the field team will be tasked with preventing unauthorized individuals from entering the field processing area.

5.1.2 Contamination Reduction Zone

Contamination reduction zones (CRZs) will be established wherever decontamination of sampling equipment and personnel exposed to sediment is conducted. On the sampling vessel, the CRZ during on-water sediment handling is the same area on the vessel deck after sampling has occurred. Decontamination of both personnel and equipment will take place in this zone to prevent the transfer of COPCs to the support zone. As appropriate, the boundaries of the field processing area will be marked with orange traffic safety cones, or equivalent.

5.2 Support Zone

The support zone will be located wherever exposed contaminated sediments are not present. In general, the support zone is where sample processing occurs after sediment samples have been sealed in sample jars and inserted into resealable plastic bags. It is also the area where chain-of-custody forms are completed, sample jar labels are prepared, and sample jars are packed for shipping. On the sample vessel the support zone is the cabin area of the vessel or on an area of the vessel deck away from the EZ and CRZ.

5.3 Project Air Monitoring Requirements

Previous investigations of the Site indicate that the main chemicals of interest for worker health and safety during the sampling event(s) are dioxins and furans. There is no evidence of significant concentrations of volatile chemicals in sediment or surface water. Therefore, respiratory protection is not expected to be needed and either Level D (off-site sample handling) or Level Modified D PPE (sampling activities) will be used.

5.4 Decontamination of Sampling Equipment

Decontamination of sampling equipment will follow procedures in Section 4.3 of the field sampling plan. No chemical solvents are expected to be required for decontamination of sampling equipment. Vessels, and equipment that have entered potentially contaminated areas will be visually inspected and, if necessary, decontaminated prior to leaving the area by rinsing with potable water. Large tools will be cleaned in the same manner. Small reusable sampling equipment, including bowls, spoons, and knives, will be rinsed, washed in phosphate-free detergent, and rinsed again. Rinsate from all decontamination activities will be collected for proper disposal. Decontamination of equipment and tools will take place within the CRZ.

The following supplies will be available to perform decontamination activities:

- Wash and rinse buckets
- Tap water and phosphate-free detergent (i.e., Alconox or Liquinox)
- Scrub brushes
- Distilled/deionized water
- Deck pump with pressurized water hose (aboard the vessel)
- Pressure washer/steam cleaner, if appropriate
- Paper towels and plastic garbage bags
- 50-gallon drums with labels and lids or 5-gallon plastic buckets with labels and lids to segregate rinsed waste water and solid waste derived from sediment sampling and processing activities.

6 REFERENCES

ACGIH. 1996. Threshold Limit Values (TLV) for Chemical Substances and Physical Agents Biological Exposure Indices (BEIs). American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

NIOSH. 1997. National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards. Keller & Associates, Neenah, WI.

OSHA. 1994. 29 CFR Parts 1910 and 1926. Hazardous Waste Operations and Emergency Response. Department of Labor, Occupational Safety and Health Administration. Accessed web site on January 8, 2010. http://www.osha.gov/pls/oshaweb/owasrch.search_form?p_doc_type=STANDARDS&p_toc_level=1&p_keyvalue=1910

OSHA. 1997. EPA/Labor Superfund Health & Safety Task Force: OSHA Audits of Superfund Sites From 1993 to 1996. Department of Labor, Occupational Safety and Health Administration. August 25, 1997. Accessed web site on January 8, 2010. http://www.osha.gov/SLTC/hazardouswaste/sftaskrpt.html

EXHIBITS

DATE: _____

PROJECT NAME: _____

PROJECT NO: _____

DAILY SAFETY BRIEFING

PERSON CONDUCTING MEETING: _____ **HEALTH & SAFETY OFFICER:** _____ **PROJECT MANAGER:** _____

TOPICS COVERED:

- ☐ Emergency Procedures and Evacuation Route
- ☐ Directions to Hospital
- ☐ HASP Review and Location
- ☐ Safety Equipment Location
- ☐ Proper Safety Equipment Use
- ☐ Employee Right-to-Know/MSDS Location
- ☐ Fire Extinguisher Location
- ☐ Eye Wash Station Location
- ☐ Buddy System
- ☐ Self and Coworker Monitoring
- ☐ Lines of Authority
- ☐ Communication
- ☐ Site Security
- ☐ Vessel Safety Protocols
- ☐ Work Zones
- ☐ Vehicle Safety and Driving/Road Conditions
- ☐ Equipment Safety and Operation
- ☐ Proper Use of PPE
- ☐ Decontamination Procedures
- ☐ Other:
- ☐ Lifting Techniques
- ☐ Slips, Trips, and Falls
- ☐ Hazard Exposure Routes
- ☐ Heat and Cold Stress
- ☐ Overhead and Underfoot Hazards
- ☐ Chemical Hazards
- ☐ Flammable Hazards
- ☐ Biological Hazards
- ☐ Eating/Drinking/Smoking

WEATHER CONDITIONS: _____

DAILY WORK SCOPE: _____

SITE-SPECIFIC HAZARDS: _____

SAFETY COMMENTS: _____

ATTENDEES

PRINTED NAME	SIGNATURE

Integral Consulting Inc.
Employee Exposure/Injury/Illness Incident Report

Employee: _____ Employee ID No._____

Sex: M ____ F ____ Office location: _____

Incident:

Possible exposure: _____ Known exposure: _____

Physical injury/illness: _____

Check only **one** below for **illness**:

____ Occupational skin diseases or disorders
____ Disorders due to physical agents
____ Dust diseases of the lungs
____ Disorders associated with repetitive motion
____ Respiratory conditions due to toxic agents
____ All other occupational illnesses

Location: _____ Contract or Overhead No. _____

Date of incident: _____ Time of incident: _____

Date incident reported: _____ Person to whom incident was reported: _____

Date of initial medical diagnosis: _____

Weather condition during incident: Temperature: _____ Humidity: _____

Wind speed and direction: _____ Cloud cover: _____

Clear: _____ Precipitation: _____

Name of materials potentially encountered:

Chemical (liquid, solid, gas, vapor, fume, mist): _____

_____

Radiological: _____

_____

Biological or Other: _____

_____

Describe the exposure/injury/illness in detail, the parts of the body affected, and how the incident occurred (attach extra sheets if necessary):

_____

_____

_____

_____

_____

_____

Was medical treatment given? Yes ___ No ____ If so, when? _____

By whom? Name of paramedic: _____

Name of physician: _____

Other: _____

Where? Onsite ___ Offsite ___

If offsite, name of hospital or clinic: _____

Length of inpatient stay (dates): _____

Was corporate management notified? No ___ Yes ___ When? _____

Name and title of manager(s) notified: _____

Did the exposure/injury/illness result in death? No ___ Yes ___ Date: _____

Did the exposure/injury/illness result in permanent disability? No ___ Yes ___ If yes, explain:

_____

Days away from work: _____ Days of restricted work activity: _____

Has the employee returned to work? No ____ Yes ____ If yes, date: _____

Name of other persons affected during the incident:

_____ _____

_____ _____

_____

Names of persons who witnessed the incident:

_____ _____

_____ _____

Name and title of field team leader or immediate supervisor at the site:

_____

Was the operation being conducted under an established safety plan? No ____ Yes ____

If yes, attach a copy. If no, explain: _____

_____

Were protective equipment and clothing used by the employee? No ___ Yes ___ If yes, list items:

_____

Did any limitations in safety equipment or protective clothing affect or contribute to exposure? If so, explain:

_____

_____

What was the employee doing when the exposure/injury/illness occurred? (Describe briefly as site reconnaissance, site categorization, sampling, etc.):

_____

_____

_____

_____

_____

_____

Describe exact onsite or offsite location where the incident occurred:

_____

_____

_____

How did the incident occur? Describe fully the factors that led to or contributed to the incident:

Attachments to this report: ___ Medical report(s) if not confidential ___ Site safety plan ___
Other relevant information ____

Employee's signature Date

Project Manager's signature Date

Site safety officer's signature Date

Corporate health and safety officer's signature Date

Management review and comments:

Medical consultant's comments:

Physician's signature Date

Corporate health and safety officer review and comments

Action required? No ____ Yes ____ If yes, what action?

Follow-up action carried out:

Corrective actions to be taken to prevent similar incidents:

Corporate health and safety officer's signature Date

Employee's signature	Date
Field team leader's signature	Date
Site safety officer's signature	Date
Project manager's signatures	Date
Supervisor's signature	Date

ATTACHMENT 2

Laboratory Control Limits

PCDD/F METHOD SUMMARY
Methods 23/0023A/1613B/8290/TO-9A

Introduction:

This summary is to provide ALSE Burlington PCDD/F method details in order to provide persons reviewing or validating this data package sufficient information to re-construct the sample calculation, data verification and review. It incorporates the analysis of PCDD/F via the following reference methods:

US EPA Office of Water, Method 1613B
US EPA Office of Solid Waste, SW846 Methods 8290A and 0023/8290A
US EPA Office of Research & Development Method TO-9A.
US EPA Office of Air Quality Planning & Standards Method 23.

Any deviations to what is listed herein would be listed in the project narrative.

To avoid the confusion and conflicting nomenclature within the methods, we have defined the labeled standards in terms relating to the time of addition to the sample or extract. Therefore;

The Field or Sampling Standards are added prior to field sampling
The Extraction Standards are added prior to extraction
The Clean-up Standards are added prior to extract clean-up
The Injection Standards are added prior to extract injection.

Calibration Standard Levels:

Six levels of standard are available for calibration as listed in Table 1. The low point (the CS0) is below method requirements and therefore is optional. a 20uL final volume is standard.

Table 1: Calibration Standards ng/mL

		CS0	CS1	CS2	CS3	CS4	CS5
Natives	2,3,7,8-TCDD	0.1	0.5	2	10	40	200
	2,3,7,8-TCDF	0.1	0.5	2	10	40	200
	1,2,3,7,8-PeCDD	0.5	2.5	10	50	200	1000
	1,2,3,7,8-PeCDF	0.5	2.5	10	50	200	1000
	2,3,4,7,8-PeCDF	0.5	2.5	10	50	200	1000
	1,2,3,4,7,8-HxCDD	0.5	2.5	10	50	200	1000
	1,2,3,6,7,8-HxCDD	0.5	2.5	10	50	200	1000
	1,2,3,7,8,9-HxCDD	0.5	2.5	10	50	200	1000
	1,2,3,4,7,8-HxCDF	0.5	2.5	10	50	200	1000
	1,2,3,6,7,8-HxCDF	0.5	2.5	10	50	200	1000
	1,2,3,7,8,9-HxCDF	0.5	2.5	10	50	200	1000
	2,3,4,6,7,8-HxCDF	0.5	2.5	10	50	200	1000
	1,2,3,4,6,7,8-HpCDD	0.5	2.5	10	50	200	1000
	1,2,3,4,6,7,8-HpCDF	0.5	2.5	10	50	200	1000
	1,2,3,4,7,8,9-HpCDF	0.5	2.5	10	50	200	1000
	OCDD	1	5	20	100	400	2000
	OCDF	1	5	20	100	400	2000
Labeled	2,3,7,8-TCDD-$^{13}C_{12}$	100	100	100	100	100	100
	2,3,7,8-TCDF-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,7,8-PeCDD-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,7,8-PeCDF-$^{13}C_{12}$	100	100	100	100	100	100
	2,3,4,7,8-PeCDF-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	100	100	100	100	100	100
	2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	100	100	100	100	100	100
	OCDD-$^{13}C_{12}$	200	200	200	200	200	200
	2,3,7,8-TCDD-$^{37}Cl_4$	0.1	0.5	2	10	40	200
Injection	1,2,3,4-TCDD-$^{13}C_{12}$	100	100	100	100	100	100
	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	100	100	100	100	100	100

Calibration Control Limits

The initial and continuing calibration control limits for all methods are presented in Table 2 below. For the initial calibration CS1 and for each calibration verification CS3, the signal to noise ratio for each quantification ion for labelled and non-labelled analytes must be greater than or equal to 10:1

Table 2: Calibration Control Limits

	1613B		M23 & TO-9A		8290A	
	Initial Cal.	Cal. Ver.	Initial Cal.	Cal. Ver.	Initial Cal.	Cal. Ver.
	%RSD	ng/mL	%RSD	% Diff	%RSD	% Diff
Natives						
2,3,7,8-TCDD	20	7.8-12.9	25	25	20	20*
2,3,7,8-TCDF	20	8.4-12.0	25	25	20	20*
1,2,3,7,8-PeCDD	20	39-65	25	25	20	20*
1,2,3,7,8-PeCDF	20	41-60	25	25	20	20*
2,3,4,7,8-PeCDF	20	41-61	25	25	20	20*
1,2,3,4,7,8-HxCDD	20	39-64	25	25	20	20*
1,2,3,6,7,8-HxCDD	20	39-64	25	25	20	20*
1,2,3,7,8,9-HxCDD	35	41-61	25	25	20	20*
1,2,3,4,7,8-HxCDF	20	45-56	25	25	20	20*
1,2,3,6,7,8-HxCDF	20	44-57	25	25	20	20*
1,2,3,7,8,9-HxCDF	20	45-56	25	25	20	20*
2,3,4,6,7,8-HxCDF	20	44-57	25	25	20	20*
1,2,3,4,6,7,8-HpCDD	20	43-58	25	25	20	20*
1,2,3,4,6,7,8-HpCDF	20	45-55	25	25	20	20*
1,2,3,4,7,8,9-HpCDF	20	43-58	25	25	20	20*
OCDD	20	79-126	25	25	20	20*
OCDF	35	63-159	30	30	20	20*
Labels						
2,3,7,8-TCDD-$^{13}C_{12}$	35	82-121	25	25	30	30**
2,3,7,8-TCDF-$^{13}C_{12}$	35	71-140	30	30	30	30**
1,2,3,7,8-PeCDD-$^{13}C_{12}$	35	62-160	30	30	30	30**
1,2,3,7,8-PeCDF-$^{13}C_{12}$	35	76-130	30	30	30	30**
2,3,4,7,8-PeCDF-$^{13}C_{12}$	35	77-130	25	25	30	30**
1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	35	85-117	25	25	30	30**
1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	35	85-118	25	25	30	30**
1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	35	76-131	25	25	30	30**
1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	35	70-143	30	30	30	30**
1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	35	74-135	-	-	-	-
2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	35	73-137	30	30	30	30**
1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	35	72-138	30	30	30	30**
1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	35	78-129	30	30	30	30**
1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	35	77-129	25	25	30	30**
OCDD-$^{13}C_{12}$	35	96-415	30	30	30	30**
2,3,7,8-TCDD-$^{37}Cl_4$	35	7.9-12.7	25	25	30	30**

* 25% is allowed for a post-run verification but when the value is above 20%, then the analyte quantification must be as per 8290A Section 8.3.2.4 and corrective action is required before more samples can be analyzed.
**35% is allowed for a post-run verification but when the value is above 30%, then the analyte quantification must be as per 8290A Section 8.3.2.4 and corrective action is required before more samples can be analyzed.

LCS Criteria:

The laboratory control sample (LCS) or the On-Going Precision and Accuracy (OPR) recovery criteria are listed in Table 3

Table 3: Acceptance Criteria for IPR and OPR[a]

	Test	IPR		
	Conc.	s[b]	X[c]	OPR
	ng/L	ng/L	ng/L	ng/L
Natives				
2,3,7,8-TCDD	10	2.8	8.3-12.9	6.7-15.8
2,3,7,8-TCDF	10	2	8.7-13.7	7.5-15.8
1,2,3,7,8-PeCDD	50	7.5	38-66	35-71
1,2,3,7,8-PeCDF	50	7.5	43-62	40-67
2,3,4,7,8-PeCDF	50	8.6	36-75	34-80
1,2,3,4,7,8-HxCDD	50	9.4	39-76	35-82
1,2,3,6,7,8-HxCDD	50	7.7	42-62	38-67
1,2,3,7,8,9-HxCDD	50	11.1	37-71	32-81
1,2,3,4,7,8-HxCDF	50	8.7	41-59	36-67
1,2,3,6,7,8-HxCDF	50	6.7	46-60	42-65
1,2,3,7,8,9-HxCDF	50	6.4	42-61	39-65
2,3,4,6,7,8-HxCDF	50	7.4	37-74	35-78
1,2,3,4,6,7,8-HpCDD	50	7.7	38-65	35-70
1,2,3,4,6,7,8-HpCDF	50	6.3	45-56	41-61
1,2,3,4,7,8,9-HpCDF	50	8.1	43-63	39-69
OCDD	100	19	89-127	78-144
OCDF	100	27	74-146	63-170
Labels				
2,3,7,8-TCDD-$^{13}C_{12}$	100	37	28-134	20-175
2,3,7,8-TCDF-$^{13}C_{12}$	100	35	31-113	22-152
1,2,3,7,8-PeCDD-$^{13}C_{12}$	100	39	27-184	21-227
1,2,3,7,8-PeCDF-$^{13}C_{12}$	100	34	27-156	21-192
2,3,4,7,8-PeCDF-$^{13}C_{12}$	100	38	16-297	13-328
1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	100	41	29-147	21-193
1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	100	38	34-122	25-163
1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	100	43	27-152	19-202
1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	100	35	30-122	21-159
1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	100	40	24-157	17-205
2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	100	37	29-136	22-176
1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	100	35	34-129	26-166
1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	100	41	32-110	21-158
1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	100	40	28-141	20-186
OCDD-$^{13}C_{12}$	200	95	41-276	26-397
2,3,7,8-TCDD-$^{37}Cl_4$	10	3.6	3.9-15.4	3.1-19.1

[a] Assuming a final volume of 20uL

[b] s = standard deviation

[c] X = Average Concentration

Extraction/Clean-up & Sampling Standard Recovery Limts:

Table 4: Extraction, Clean-up, Injection & Sampling Standard Recovery Limits

	1613B or 8290A (non Stack)		M23 or 0023A/8290A or TO-9A	
	(% Rec.)	Ref.	(% Rec.)	Ref.
Extraction Standard				
2,3,7,8-TCDD-$^{13}C_{12}$	25-164	a	40-130	b
2,3,7,8-TCDF-$^{13}C_{12}$	24-169	a	40-130	b
1,2,3,7,8-PeCDD-$^{13}C_{12}$	25-181	a	40-130	b
1,2,3,7,8-PeCDF-$^{13}C_{12}$	24-185	a	40-130	b
2,3,4,7,8-PeCDF-$^{13}C_{12}$	21-178	a	-	
1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	32-141	a	-	
1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	28-130	a	40-130	b
1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	26-152	a	-	
1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	26-123	a	40-130	b
1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	29-147	a	-	
2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	28-136	a	40-130	c,d
1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	23-140	a	25-130	b
1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	28-143	a	25-130	b
1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	26-138	a	-	
OCDD-$^{13}C_{12}$	17-157	a	25-130	b
Clean-up Standard				
2,3,7,8-TCDD-$^{37}Cl_4$	35-197	a	-	
1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	-		40-130	b
Injection Standard				
1,2,3,4-TCDD-$^{13}C_{12}$	30-300	d	30-300	d
1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	30-300	d	30-300	d
Sampling Standard				
2,3,7,8-TCDD-$^{37}Cl_4$	-		70-130	b
2,3,4,7,8-PeCDF-$^{13}C_{12}$	-		70-130	b
1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	-		70-130	b
1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	-		70-130	b
1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	-		70-130	b

References & Notes

[a] from OW method 1613B

[b] from OAQPS method 23

[c] this extraction standard is not required in methods 23 and 0023A/8290A

[d] ALS In-house criteria

Reporting Limits:

Unless indicated in the otherwise, the PCDD/F data is reported down to 2.5:1 signal to noise for each isomer grouping for each extract injection. This is consistent to SW846 8290 defined protocols (i.e. EDL or Estimated Detection Limit) and is commonly applied throughout the industry to all the HRMS PCDD/F methods applicable to this method summary.

Method Blank:

The method blank levels must be below the response to the low calibration standard, CS0 or CS1, whichever low calibration point is being applied to the project.

MS/MSD:

The % relative difference between the MS and MSD spike recoveries should be less than or equal to 20%.

Instrument/Run Performance Criteria:

1. Elution windows must be defined by a 'Window Performance Mix' at the beginning of each 12-hour run sequence
2. GC performance criteria of 25% maximum valley between 2,3,7,8-TCDD and it's neared eluting isomers (DB5) or 2,3,7,8-TCDF and it's nearest eluting isomers (DB225).
3. At the beginning of and just following the end of each 12 hour run sequence, the instrument must be checked to demonstrate a resolution of 10,000 for each quantification window.
4. For method 1613B, the relative retention times (RRT) of the compounds in the daily CS3 calibration verification must fall into the ranges presented in Table 4.
5. For all calibrations, QC samples and field samples, the absolute retention time (RT) for 1,2,3,4-TCDD-13C12 must be >25.0 min on a DB5 column and >15.0 min on a DB225 column.
6. The RT in the daily CS3 verification standards must be within 15 seconds of the CS3 in the initial calibration run.
7. The maximum time between scans within a descriptor is 1 second.
8. Lock mass deviations to the average response must be less than or equal 20%.

Laboratory Duplicates:

The % relative difference between duplicates should be less than or equal to 25% but only where the response is greater than the low calibration standard.

Analyte Identification Criteria:

1. Ion ratio must be within 15% of theoretical or within 10% of the most recent CS3.
2. The retention time (RT) of the peak maxima for each pair of quantification ions must be no more than 2 seconds (i.e. 2 scans) difference.
3. The retention time (RT) of the peak maxima of all 2,3,7,8- substituted native analytes must be within -1 to +3 seconds of the RT of corresponding $^{13}C_{12}$-labelled isomer of that injection run.
4. For those native analytes without a corresponding labelled isomer, the relative retention time (RRT) must be within 0.005 of the relative retention time observed in the daily CS3 run.
5. When there is a significant PCDPE interference observed, then a peak in the PCDF channel is not confirmed to be PCDF. [Significant PCDPE interference is identified when there is a PCDPE parent ion peak 10% or more of the response of a peak at the same RT (i.e. within 2 seconds) in the corresponding PCDF channel.]
6. For any peak to be identified as a positive PCDD/F response, that peak must be within the retention time windows defined by the daily analysis of Window Performance Mixture.

Table 4: Quantitation References and Method 1613B RT References and RRT

Analyte	Stack/Ambient Quantitation Reference	Method 1613B RT Reference Solids/ Waters Quantitation Reference	Method 1613B RRT
Compounds using 1,2,3,4-TCDD-$^{13}C_{12}$ as injection standard			
2,3,7,8-TCDF	2,3,7,8-TCDF-$^{13}C_{12}$	2,3,7,8-TCDF-$^{13}C_{12}$	0.999-1.003
2,3,7,8-TCDD	2,3,7,8-TCDD-$^{13}C_{12}$	2,3,7,8-TCDD-$^{13}C_{12}$	0.999-1.002
1,2,3,7,8-PeCDF	1,2,3,7,8-PeCDF-$^{13}C_{12}$	1,2,3,7,8-PeCDF-$^{13}C_{12}$	0.999-1.002
2,3,4,7,8-PeCDF	1,2,3,7,8-PeCDF-$^{13}C_{12}$	2,3,4,7,8-PeCDF-$^{13}C_{12}$	0.999-1.002
1,2,3,7,8-PeCDD	1,2,3,7,8-PeCDD-$^{13}C_{12}$	1,2,3,7,8-PeCDD-$^{13}C_{12}$	0.999-1.002
2,3,7,8-TCDF-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	0.923-1.103
2,3,7,8-TCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	0.976-1.043
2,3,7,8-TCDD-$^{37}Cl_4$	2,3,7,8-TCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	0.989-1.052
1,2,3,7,8-PeCDF-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1.000-1.425
2,3,4,7,8-PeCDF-$^{13}C_{12}$	1,2,3,7,8-PeCDF-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1.011-1.526
1,2,3,7,8-PeCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1,2,3,4-TCDD-$^{13}C_{12}$	1.000-1.567
Compounds using 1,2,3,7,8,9-HxCDD-$^{13}C_{12}$ as injection standard			
1,2,3,4,7,8-HxCDF	1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	0.999-1.001
1,2,3,6,7,8-HxCDF	1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	0.997-1.005
1,2,3,7,8,9-HxCDF	1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	0.999-1.001
2,3,4,6,7,8-HxCDF	2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	0.999-1.001
1,2,3,4,7,8-HxCDD	1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	0.999-1.001
1,2,3,6,7,8-HxCDD	1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	0.998-1.004
1,2,3,7,8,9-HxCDD[a]	1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	[a]	1.000-1.019
1,2,3,4,6,7,8-HpCDF	1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	0.999-1.001
1,2,3,4,7,8,9-HpCDF	1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	0.999-1.001
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	0.999-1.001
OCDF	OCDD-$^{13}C_{12}$	OCDD-$^{13}C_{12}$	0.999-1.008
OCDD	OCDD-$^{13}C_{12}$	OCDD-$^{13}C_{12}$	0.999-1.001
1,2,3,4,7,8-HxCDF-$^{13}C_{12}$	1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	0.944-0.970
1,2,3,6,7,8-HxCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	0.949-0.975
1,2,3,7,8,9-HxCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	0.977-1.047
2,3,4,6,7,8-HxCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	0.959-1.021
1,2,3,4,7,8-HxCDD-$^{13}C_{12}$	1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	0.977-1.000
1,2,3,6,7,8-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	0.981-1.003
1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1.043-1.085
1,2,3,4,7,8,9-HpCDF-$^{13}C_{12}$	1,2,3,4,6,7,8-HpCDF-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1.057-1.151
1,2,3,4,6,7,8-HpCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1.086-1.110
OCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1,2,3,7,8,9-HxCDD-$^{13}C_{12}$	1.032-1.311

[a] For solids/waters via 1612B, 1,2,3,7,8,9-HXCDD is quantified against the average responses of 1,2,3,4,7,8-HxCDD-$^{13}C_{12}$ and 1,2,3,6,7,8-HxCDD-$^{13}C_{12}$ while 1,2,3,6,7,8-HxCDD-$^{13}C_{12}$ is the RT reference.

ATTACHMENT 3

Standard Operating Procedures (SOP)

STANDARD OPERATING PROCEDURE (SOP) 1
SURFACE SEDIMENT SAMPLING (See Note)

SCOPE AND APPLICATION

This SOP defines and standardizes the methods for collecting surface sediment samples from freshwater or marine environments. It is general in nature, and therefore applies to a broad range of sampling environments and conditions. Surface sediments are defined as those from 0 to at most 10 cm below the sediment-water interface. The actual definition of surface sediments is typically program-specific and depends on the purpose of the study and the regulatory criteria (if any) to which the data will be compared. This SOP utilizes and augments the procedures outlined in USEPA (1996) and ASTM (2003) guidelines. A goal of this SOP is to ensure that the highest quality, most representative data are collected, and that these data are comparable to data collected by different programs that follow the USEPA (1996) guidelines.

SUMMARY OF METHOD

Sediment samples for chemical analysis are collected using a surface sediment sampling device (e.g., grab sampler). If a sample meets acceptability guidelines, overlying water is carefully siphoned off the surface, and the sediment is described in the field log. Sediment samples for chemical analysis may be collected directly from the sampler (e.g., volatile organic compounds and sulfides), or sediment from the sampler may be homogenized using decontaminated, stainless-steel containers and utensils prior to being placed in sample jars. Sediment from several sampler casts may also be composited and homogenized prior to being placed in sample jars.

SUPPLIES AND EQUIPMENT

A generalized supply and equipment list appears below. Additional equipment may be required depending on project requirements.

- Grab sampler or box corer (see examples below in procedures for "Sediment Sample Collection")
- Field equipment
    - Siphoning hose
    - Stainless-steel bowls or containers
    - Stainless-steel spoons, spatulas, and/or mixer
    - Project-specific decontamination supplies (e.g., Alconox™ detergent, 0.1 N nitric acid, methanol, hexane, distilled/deionized water)
    - Personal protective equipment for field team (e.g., rain gear, safety goggles, hard hats, nitrile gloves)
    - First aid kit
    - Cell phone
    - Camera
    - Sample containers
    - Bubble wrap
    - Sample jar labels
    - Clear tape
    - Permanent markers
    - Indelible black ink pens
    - Pencils
    - Coolers
    - Ice

- Documentation
    - Waterproof field logbook
    - Field sampling plan
    - Health and safety plan

PROCEDURES

Sediment Sample Collection

Use a sampler that obtains a quantifiable volume of sediment with minimal disturbance of the surrounding sediments to collect sediment for chemical analyses. The sampler should be composed of a material such as stainless steel or aluminum, or have a noncontaminating coating such as Teflon™. Samplers capable of providing high-quality sediment samples include grab-type samplers (e.g., van Veen, Ekman, Smith-McIntyre, Young grab, Power Grab and modified-ponar grab) and box cores (Soutar, mini-Soutar, Gray-O'Hara, spade core). Some programs require a sampler that collects from a specific area (e.g., 0.1 m^2). Most sampling devices are typically a standard size; however, some non-standard sizes are available to meet the requirements of specific programs. Grab samplers, especially van Veen grab and Ekman grab, are the most commonly used samplers to collect surface sediment. Power Grab samplers are often used for programs requiring collection of sediment deeper than 10 cm (4 in.) or in areas with debris. Depending on grab weight and water depth, use a hydraulic winch system to deploy the heavier samplers at a rate not exceeding 1 m/second to minimize the bow wake associated with sampler descent. Once the sampler hits the bottom, close the jaws slowly and bring the sampler to the deck of the vessel at a rate not exceeding 1 m/second to minimize any washing and disturbance of the sediment within the sampler. At the moment the sampler hits the bottom, record the time, depth, and location of sample acquisition in the field logbook. Retrieve and secure the sampler, and carefully siphon off any overlying water. Inspect the sample to determine acceptability using the following criteria:

- There is minimal or no excessive water leakage from the jaws of the sampler
- There is no excessive turbidity in the water overlying the sample
- The sampler is not over-penetrated
- The sediment surface appears to be intact with minimal disturbance
- The program-specified penetration depths are attained.

If the sample meets acceptability criteria, record the sample and enter observations onto a sample description form or log.

Sample Processing

Using a stainless-steel spoon, remove sediment from the sampler for chemical analyses. Depending on programmatic goals, remove the upper 10 cm (4 in.) of sediment. To prevent possible cross-contamination, do not use sediments touching the margins of the sampler. Complete all sample logs, labels, custody seals, and chain-of-custody forms, and record sample information in the field notebook.

Collect samples for volatile compounds (either organics or sulfides) first using a decontaminated stainless-steel spoon while sediment is still in the sampler. These sediments are not homogenized. Tightly pack the volatile organics sample jar with sediment (to eliminate obvious air pockets) and fill it so that no headspace remains in the jar. Alternatively, if there is adequate water in the sediment, fill the container to overflowing so that a convex meniscus forms at the top, and then carefully place the cap on the jar. Once sealed, the jar should contain no air bubbles.

If sample homogenizing or compositing is to take place, place the remaining sediment in a precleaned, stainless-steel bowl. Once you have collected a sufficient amount of sediment, mix the sediment until it is of uniform color and smooth consistency. Dispense the sediment into precleaned sample jars for the

various chemical or biological analyses. For chemical testing, fill sample jars to the top with sediment to minimize available headspace. This procedure will minimize any oxidation reactions within the sediment. After dispensing the sediment, place the containers into coolers with ice and either ship them directly to the analytical laboratories or transport them to a storage facility.

REFERENCES

ASTM. 2003. *Standard Practice for Collecting Benthic Macroinvertebrates with Ekman Grab Sampler*. ASTM Standards on Disc, Volume 11.05.

USEPA. 1996. Puget Sound Estuary Program: Recommended protocols for measuring selected environmental variables in Puget Sound. Prepared for U.S. Environmental Protection Agency, Region 10, and Puget Sound Estuary Program, Seattle, WA. Tetra Tech and HRA, Inc., Bellevue, WA.

Note: Based on S0P SD-04 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

STANDARD OPERATING PROCEDURE (SOP) 2
FIELD CLASSIFICATION OF SEDIMENT (See Note)

SCOPE AND APPLICATION

This SOP presents the field classification of sediments. Sediment descriptions should be precise and comprehensive without being verbose. Assumptions and personal comments should not be included in the sediment descriptions. These descriptions will be used to interpret environmental conditions and other potential properties. Sediment descriptions should be recorded in either the observing scientist's field logbook, or if subsurface sediment is collected, then the sediment description column of the Field Borehole Form should be completed for each core collected. If no difference between consecutive sediment samples exists, subsequent descriptions can be noted as "same as above," or minor changes such as

"increasing sand" or "becomes dark brown" can be added. After the overlying water is removed, characterize the sediment. Sediment characteristics that are often recorded in the field logbook or the Field Borehole Core Form if subsurface sediment is collected, include:

- Sediment type (e.g., silt, sand)
- Texture (e.g., fine grain, coarse, poorly sorted sand)
- Color
- Presence/location/thickness of the redox potential discontinuity layer (a visual indication of black is often adequate for documenting anoxia)
- Approximate percentage of moisture
- Presence of biological structures (e.g., chironomids, tubes, macrophytes) and the approximate percentage of these structures
- Presence of organic debris (e.g., twigs, leaves) and the approximate percentage of debris
- Presence of shells and the approximate percentage of shells
- Stratification, if any
- Presence of a sheen
- Odor (e.g., hydrogen sulfide, oil, creosote).

In addition, the project specific field sampling plan should be reviewed to determine if there are any project specific reporting requirements.

In general, the similarities of consecutive sediment samples should be noted. Examples of surface sediment descriptions are provided in Table 1. The minimum elements of the sediment descriptions are discussed below. The format of sediment descriptions for each sample should be consistent throughout the logbook.

Table SD-13(1). Example of Surface Sediment Desctiptions

Station No.	Grab No.	Example Descriptions
TC01	1	SILT, mottled dark gray (10YR 4/1) with thin layer < 1 cm of very pale brown (10YR 7/4) on surface. Occasional roots, some twigs, and leaves on surface. Slight reducing odor. Sheen on overlying water in grab.
TC02	1	Sandy SILT, fine sand, dark gray (10YR 4/1) throughout grab, with 10 percent medium to coarse sand, trace woody debris. Chironomid on surface.

TC02	2	Same description as first grab at Station TC02.
TC02	3	Same description as first grab at Station TC02, but no sand (SILT only) and color is very dark gray (10YR 3/1) with no chironomid present.

Definition of Sediment Types

Fine grained sediments are classified as either silts or clays. Field determinations of silts and clays are based on observations of dry strength, dilatancy, toughness, and plasticity. Field procedures for these tests are included in ASTM D 2488-84. If these tests are used, the results should be included in the sediment description. Sediments with high plasticity can be emphasized by describing them as "silty CLAY with high plasticity." Plasticity is an important descriptor because a sediment can be dilatant/nonplastic and serve as a transport pathway, or it can be highly plastic and very impervious. Coarse grained sediments are classified as predominantly sand. The gradation of a coarse grained sediment is included in the specific sediment name (i.e., fine to medium SAND with silt). Estimating the percentage of various size ranges following the group name is encouraged for mixtures of silty sand and sand. If applicable, use the modifiers "poorly graded" or "well graded" when describing the sand component of the sediment.

Color

The basic color of a sediment, such as brown or gray, must be provided in the description. The color term can be modified by adjectives such as light, dark, or very dark. Especially note streaking or mottling. The color chart designations provided in the Munsell color guide can be used.

Moisture Content

The degree of moisture present in the sediment should be defined as moist, wet, or very wet. The percent moisture content should be estimated.

Other Components

Other components, such as organic debris and shell fragments, should be preceded by the appropriate adjective reflecting relative percentages: trace (0–5 percent), few (5–10 percent), little (15–25 percent), and some (30–45 percent). The word "occasional" can be applied to random particles of a larger size than the general sediment matrix (i.e., occasional stone, large piece of wood).

Additional Descriptions

Features such as sloped surface in the grab, root holes, odor, and sheen should be noted if they are observed. Anything unusual should be noted. Additional sediment descriptions may be made at the discretion of the project manager or as the field conditions warrant.

Note: Based on S0P SD-13 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

STANDARD OPERATING PROCEDURE (SOP) 3 DECONTAMINATION OF SEDIMENT SAMPLING EQUIPMENT (See Note)

SCOPE AND APPLICATION

This SOP describes procedures for decontaminating sampling and processing equipment contaminated by either inorganic or organic materials. It is general in nature, and therefore applies to a broad range of sampling environments and conditions. To prevent potential cross contamination of samples, all reusable sediment sampling and processing equipment is decontaminated before each use. At the sample collection site, a decontamination area is established in a clean location that is upwind of actual sampling locations, if possible. All sediment sampling and processing equipment is cleaned in this location. Decontaminated equipment is stored away from areas that may cause recontamination. When handling decontamination chemicals, field personnel must follow all relevant procedures and wear protective clothing as stipulated in the site-specific health and safety plan (HSP).

Sampling equipment (e.g., van Veen, Ekman, Ponar, core tubes) may be used to collect samples that will

1) undergo a full-suite analysis (organics, metals, and conventional parameters) or
2) be analyzed for metals and conventional parameters only.

Decontamination of sampling equipment used for both analyte groups should follow the order of a detergent wash, site water rinse, organic solvent rinse, and final site water rinse. Sample processing equipment (e.g., bowls, spoons) has a final rinse with distilled/deionized water rinse instead of site water. If the surface of stainless steel equipment appears to be rusting (possibly due to prolonged contact with organic-rich sediment), it should undergo an acid rinse and a site-water rinse at the end of each sampling day to minimize corrosion.

EQUIPMENT AND REAGENTS REQUIRED

Equipment required for decontamination includes the following:

- Polyethylene or polypropylene tub (to collect solvent rinsate)
- Plastic bucket(s) (e.g., 5-gal bucket)
- Tap water or site water
- Carboy, distilled/deionized water (analyte-free; received from testing laboratory or other reliable source)
- Properly labeled squirt bottles
- Funnels
- Alconox®, Liquinox®, or equivalent industrial detergent
- Pesticide-grade acetone and hexane (consult the project-specific field sampling plan [FSP], as the solvents may vary by EPA region or state)
- 10 percent (v/v) nitric acid (reagent grade) for inorganic contaminants
- Baking soda
- Long-handled, hard-bristle brushes
- Extension arm for cleaning core liners
- Plastic sheeting, garbage bags, and aluminum foil
- Core liner caps or plastic wrap and rubber bands
- Personal protective equipment as specified in the health and safety plan.

PROCEDURES

Decontamination Procedures for Full Suite Analysis (Organic, Metal, or Conventional Parameters)

Two organic solvents are used in this procedure. The first is miscible with water (e.g., ethanol) and is intended to scavenge water from the surface of the sampling equipment and allow the equipment to dry quickly. This allows the second solvent to fully contact the surface of the sampler. Make sure that the solvent ordered is anhydrous or has a very low water content (i.e.,< 1 percent). If ethanol is used, make sure that the denaturing agent in the alcohol is not an analyte in the samples. The second organic solvent is hydrophobic (e.g., hexane) and is intended to dissolve any organic chemicals that are on the surface of the equipment. The exact solvents used for a given project may vary by EPA region or state (see project-specific FSP). If specified in the project-specific FSP, isopropanol or acetone can be substituted for ethanol, and methanol can be substituted for hexane in the decontamination sequence. The choice of solvents is also dependent on the kind of material from which the equipment is made (e.g., acetone cannot be used on polycarbonate), and the ambient temperature (e.g., hexane is too volatile in hot climates). In addition, although methanol is sometimes slightly more effective than other solvents, its use is discouraged due to potential toxicity to sampling personnel.

The specific procedures for decontaminating sediment sampling equipment and sediment compositing equipment are as follows:

1. Rinse the equipment thoroughly with tap or site water to remove visible sediment. Perform this step onsite for all equipment, including core liners that will not be used again until the next day of sampling. After removing visible solids, set aside sampling equipment that does not need to be used again that day; this equipment should be thoroughly cleaned in the field at the end of the day.

2. Pour a small amount of concentrated laboratory detergent into a bucket (i.e., about 1−2 tablespoons per 5-gal bucket) and fill it halfway with tap or site water. If the detergent is in crystal form, make sure all crystals are completely dissolved prior to use.

3. Scrub the equipment in the detergent solution using a long-handled brush with rigid bristles. For the polycarbonate core liners, use a round brush attached to an extension arm to reach the entire inside of the liners, scrubbing with a back-and-forth motion. Be sure to clean the outside of core liners, bowls, and other pieces that may be covered with sediment.

4. Double rinse the equipment with tap or site water and set right-side-up on a stable surface to drain. The more completely the equipment drains, the less solvent will be needed in the next step. Do not allow any surface that will come in contact with the sample to touch any contaminated surface.

5. If the surface of stainless steel equipment appears to be rusting (this will occur during prolonged use in anoxic marine sediments), passivate [1] the surface as follows (if no rust is present, skip to next step). Rinse with a 10 percent (v/v) nitric acid solution using a squirt bottle, or wipe all surfaces using a saturated paper towel. Areas showing rust may require some rubbing with the paper towel. If using a squirt bottle, let the excess acid drain into the waste container (which may need to be equipped with a funnel). Double rinse equipment with tap or site water and set right-side-up on a stable surface to drain thoroughly.

6. Carefully rinse the equipment with ethanol from a squirt bottle, and let the excess solvent drain into a waste container (which may need to be equipped with a funnel). Hold core liners over the waste container and turn them slowly so the stream of solvent contacts the entire surface. Turn the sample

apparatus (e.g., grab sampler) on its side and open it to wash it most effectively. Set the equipment in a clean location and allow it to air dry. Use only enough solvent to scavenge all of the water and flow off the surface of the equipment (i.e., establish sheet flow) into the waste container. Allow equipment to drain as much as possible. Ideally, the equipment will be dry. The more thoroughly it drains, the less solvent will be needed in the next step.

7. Carefully rinse the drained or air-dried equipment with hexane from a squirt bottle, and let the excess solvent drain into the waste container (which may need to be equipped with a funnel). If necessary, widen the opening of the squirt bottle to allow enough solvent to run through the core liners without evaporating. Hexane acts as the primary solvent of organic chemicals. Ethanol is soluble in hexane but water is not. If water beading occurs, it means that the equipment was not thoroughly rinsed with acetone or that the acetone that was purchased was not free of water. When the equipment has been rinsed with hexane, set it in a clean location and allow the hexane to evaporate before using the equipment for sampling. Use only enough solvent to scavenge all of the acetone and flow off the surface of the equipment (i.e., establish sheet flow) into the waste container.

8. Do a final rinse with site water for the sampling equipment (i.e., van Veen, Ekman, Ponar, core tubes) and with distilled/deionized water for processing equipment (i.e., stainless-steel bowls and spoons). Equipment does not need to be dried before use.

9. If the decontaminated sampling equipment is not to be used immediately, wrap small stainless-steel items in aluminum foil (dull side facing the cleaned area). Seal the polycarbonate core liners at both ends with either core caps or cellophane plastic and rubber bands. Close the jaws of the Ekman and Ponar grab samplers and wrap in aluminum foil. If the sample collection or processing equipment is cleaned prior to mobilization and transported to the site, then the decontaminated equipment will be wrapped in aluminum foil (dull side facing the cleaned area) and stored and transported in a clean plastic bag (e.g., a trash bag) until ready for use, unless the project-specific FSP lists special handling procedures.

10. Rinse or wipe with a wetted paper towel all stainless-steel equipment at the end of each sampling day with 10 percent (v/v) normal nitric acid solution. Follow with a freshwater rinse (site water is okay as long as it is not brackish or salt water).

11. After decontaminating all of the sampling equipment, place the disposable gloves and used foil in garbage bags for disposal in a solid waste landfill. When not in use, keep the waste solvent container closed and store in a secure area. The waste solvent should be transferred to empty solvent bottles and disposed of at a licensed facility per the procedures listed in the project-specific FSP. When not in use, keep the waste acid container closed and store in a secure area. The acid waste should be neutralized with baking soda and disposed of per the procedures listed in the project-specific FSP.

Decontamination Procedures for Metals and Conventional Parameters Only

The specific procedures for decontaminating sediment sampling equipment and sediment processing equipment are as follows:

1. Rinse the equipment thoroughly with tap or site water to remove the visible sediment. Perform this step onsite for all equipment, including core liners that will not be used again until the next day of sampling. Set aside pieces that do not need to be used again that day; these pieces should be thoroughly cleaned in the field at the end of the day.

2. Pour a small amount of concentrated laboratory detergent into a bucket (i.e., about 1−2 tablespoons per 5-gal bucket) and fill it halfway with tap or site water. If the detergent is in crystal form, make sure all crystals are completely dissolved prior to use.

3. Scrub the equipment in the detergent solution using a long-handled brush with rigid bristles. For the polycarbonate core liners, use a round brush attached to an extension arm to reach the entire inside of the liners, scrubbing with a back-and-forth motion. Be sure to clean the outside of core liners, bowls, and other pieces that may be covered with sediment.

4. Double-rinse the equipment with tap or site water and set right-side-up on a stable surface to drain. Do not allow any surface that will come in contact with the sample to touch any contaminated surface.

5. If the surface of stainless steel equipment appears to be rusting (this will occur during prolonged use in anoxic marine sediments), passivate[1] the surface as follows (if no rust is present, skip to next step). Rinse with a 10 percent (v/v) nitric acid solution using a squirt bottle, or wipe all surfaces using a saturated paper towel. Areas showing rust may require some rubbing with the paper towel. If using a squirt bottle, let the excess acid drain into the waste container (which may need to be equipped with a funnel). Double-rinse sampling equipment with tap or site water and set right-side-up on a stable surface to drain. Double-rinse processing equipment with distilled/deionized water and allow to drain.

6. If the decontaminated sampling equipment is not to be used immediately, wrap small stainless-steel items in aluminum foil (dull side facing the cleaned area). Seal the polycarbonate core liners at both ends with either core caps or cellophane plastic and rubber bands. Close the jaws of the Ekman and Ponar grab samplers and wrap in aluminum foil. If the sample collecting or processing equipment is cleaned prior to mobilization and transported to the site, then the decontaminated equipment will be wrapped in aluminum foil (dull side facing the cleaned area) and stored and transported in a clean plastic bag until ready for use, unless the project-specific FSP lists special handling procedures.

7. After decontaminating all of the sampling equipment, place the disposable gloves and used foil in garbage bags for disposal in a solid waste landfill. When not in use, keep the waste acid container closed and store in a secure area. The acid waste should be neutralized with baking soda and disposed of per the procedures listed in the project specific FSP.

[1] Passivation is the process of making a material less reactive relative to another material. For example, before sediment is placed in a stainless-steel container, the container can be passivated by rinsing it with a dilute solution of nitric acid and deionized water.

Note: Based on S0P SD-01 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

STANDARD OPERATING PROCEDURE (SOP) 4
(See Note)

SAMPLE CUSTODY

SCOPE AND APPLICATION

This SOP describes procedures for custody management of environmental samples. A stringent, established program of sample chain-of-custody will be followed during sample storage and shipping activities to account for each sample. The procedure outlined herein will be used with SOP 5, which covers sample packaging and shipping; SOP 6, which covers the use of field logbooks and other types of field documentation; and SOP 7, which covers sample labeling. Chain-of-custody (COC) forms ensure that samples are traceable from the time of collection through processing and analysis until final disposition. A sample is considered to be in a person's custody if any of the following criteria are met:

1. The sample is in the person's possession
2. The sample is in the person's view after being in his or her possession
3. The sample is in the person's possession and is being transferred to a designated secure area
4. The sample has been locked up to prevent tampering after it was in the person's possession.

At no time is it acceptable for samples to be outside of the field personnel's custody unless the samples have been transferred to a secure area (i.e., locked up). If the samples cannot be placed in a secure area, then a field team member must physically remain with the samples (e.g., at lunch time one team member must remain with the samples).

CHAIN-OF-CUSTODY FORMS

The COC form is critical because it documents sample possession from the time of collection through final disposition. The form also provides information to the laboratory regarding what analyses are to be performed on the samples that are shipped. Complete the COC form after each field collection activity and before shipping the samples to the laboratory. Sampling personnel are responsible for the care and custody of the samples until they are shipped. The individuals relinquishing and receiving the samples must sign the COC form(s), indicating the time and date of the transfer, when transferring possession of the samples.

A COC form consists of three-part carbonless paper with white, yellow, and pink copies. The sampling team leader keeps the pink copy. The white and yellow sheets are placed in a sealed plastic bag and secured inside the top of each transfer container (e.g., cooler). Field staff retain the pink sheet for filing at TWE's office location. Each COC form has a unique identifying number. This number and the samples on the form must be recorded in the field logbook.

Record on the COC form the project-assigned sample number, the sample collection date and time, sample type, project name, and sampling personnel. In addition, the COC form provides information on the preservative or other sample pretreatment applied in the field and the analyses to be conducted by referencing a list of specific analyses or the statement of work for the laboratory. The COC form is sent to the laboratory along with the sample(s).

PROCEDURES

Use the following guidelines to ensure the integrity of the samples:

1. Sign and date each COC form. Have the person who relinquishes custody of the samples also sign this form.

2. At the end of each sampling day and prior to shipping or storage, make COC entries for all samples. Check the information on the labels entries.

3. Do not sign the COC form until the team leader has checked the information for inaccuracies. Make corrections by drawing a single line through any incorrect entry, and then initial and date it. Make revised entries in the space below the entries. After making corrections, mark out any blank lines remaining on the COC form, using single lines that are initialed and dated. This procedure will prevent any unauthorized additions. At the bottom of each COC form is a space for the signatures of the persons relinquishing and receiving the samples and the time and date of the transfer. The time the samples were relinquished should match exactly the time they were received by another party. Under no circumstances should there be any time when custody of the samples is undocumented.

4. If samples are sent by a commercial carrier not affiliated with the laboratory, such as FedEx or United Parcel Service (UPS), record the name of the carrier on the COC form. Also enter on the COC form any tracking numbers supplied by the carrier. The time of transfer should be as close to the actual drop-off time as possible. After signing the COC forms and removing the pink copy, seal them inside the transfer container.

5. If errors are found after the shipment has left the custody of sampling personnel, make a corrected version of the forms and send it to all relevant parties. Fix minor errors by making the change on a copy of the original with a brief explanation and signature. Errors in the signature block may require a letter of explanation.

CUSTODY SEAL

As security against unauthorized handling of the samples during shipping, affix two custody seals to each sample cooler. Place the custody seals across the opening of the cooler (front right and back left) prior to shipping. Be sure to secure the seals with a wrapping of clear packing tape so they cannot be removed during shipping.

SHIPPING AIR BILLS

When samples are shipped from the field to the testing laboratory via a commercial carrier (e.g., FedEx, UPS), the shipper provides an air bill or receipt. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting the sender's copy of all shipping air bills to be copied at TWE's office. Note the air bill number (or tracking number) on the applicable COC forms or, alternatively, note the applicable COC form number on the air bill to enable the tracking of samples if a cooler becomes lost.

ACKNOWLEDGMENT OF SAMPLE RECEIPT FORMS

In most cases, when samples are sent to a testing laboratory, an Acknowledgment of Sample Receipt form is emailed to the project manager the day the samples are received by the laboratory. The person receiving this form is responsible for reviewing it, making sure that the laboratory has received all the samples that were sent, and verifying that the correct analyses were requested. If an error is found, call the laboratory immediately, and document any decisions made during the telephone conversation, in writing, on the Acknowledgment of Sample Receipt form. In addition, correct the COC form and fax the corrected version to the laboratory. Submit the Acknowledgment of Sample Receipt form (and any modified COC forms) to be copied.

Note: Based on S0P AP-03 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

STANDARD OPERATING PROCEDURE (SOP) 5
SAMPLE PACKAGING AND SHIPPING (See Note)

SCOPE AND APPLICATION

This SOP describes specific requirements for sample packaging and shipping to ensure the proper transfer and documentation of environmental samples collected during field operations. It is general in nature, and therefore applies to a broad range of sampling environments and conditions. Procedures for the careful and consistent transfer of samples from the field to the laboratory are outlined herein. This SOP also presents the method to be used when packing samples that will either be hand delivered or shipped by commercial carrier to the laboratory.

EQUIPMENT AND SUPPLIES REQUIRED

Make sure that you have the equipment and supplies necessary to properly pack and ship environmental samples, including the following:

- Project-specific sampling and analysis plan (SAP)
- Project-specific field logbook
- Sealable airtight bags in assorted sizes (e.g., Ziploc®)
- Wet ice in doubled, sealed bags
- Cooler(s)
- Bubble wrap
- Fiber-reinforced packing tape, clear plastic packing tape, and duct tape
- Scissors or knife
- Chain-of-custody (COC) forms
- COC seals
- Large plastic garbage bags (preferably 3 mil [0.003 in.] thick)
- Paper towels
- "Fragile," "This End Up," or "Handle With Care" labels
- Mailing labels
- Air bills for overnight shipment
- Shipping address of laboratory

PROCEDURE

Customize the logistics for sample packaging and shipping to each study. Depending on the logistics of the operation, field personnel may transport samples to the laboratory or use a commercial courier or shipping service. In the latter case, TWE field personnel must be aware of any potentially limiting factors to timely shipping, such as availability of overnight service and weekend deliveries to specific areas, and shipping regulations regarding "restricted articles" (e.g., dry ice, formalin) prior to shipping the samples.

SAMPLE PREPARATION

Take the following steps to ensure the proper transfer of samples from the field to the laboratories:
At the sample collection site:

1. Document all samples using the proper logbooks or field forms (see SOP 6), required sample container identification (i.e., sample labels with tag numbers), and COC form (example provided in SOP AP-03). Fill out the COC form as described in SOP 4, and use the sample labeling techniques provided in SOP 7.

2. Make all applicable laboratory quality control sample designations on the COC forms. Clearly identify samples that will be archived for future possible analysis. Label these samples as follows: "Do Not

Analyze: Hold and archive for possible future analysis." Some laboratories interpret "archive" to mean that they should continue holding the residual sample after analysis.

3. Notify the laboratory contact and the TWE project quality assurance/quality control (QA/QC) coordinator that samples will be shipped and the estimated arrival time. Send copies of all COC forms to TWE's project QA/QC coordinator or project manager, as appropriate.

4. Keep the samples in the possession of the sampling personnel at all times. Lock and secure any temporary onsite sample storage areas to maintain sample integrity and COC requirements.

5. Clean the outside of all dirty sample containers to remove any residual material that may lead to cross-contamination.

6. Complete the COC form as described in SOP 4, and retain the back (pink) copy for project records prior to sealing the cooler. Check sample containers against the COC form to ensure all the samples that were collected are in the cooler.

7. Store each sample container in a sealed plastic bag that allows the sample label (example provided in SOP 4) to be read. Before sealing the bags, ensure that volatile organic analyte (VOA) vials are encased in a foam sleeve or in bubble wrap.

8. If the samples require storage at a specific temperature, place enough ice in the sample cooler to maintain the temperature (e.g., 4° C) throughout the sampling day.

At the sample processing area (immediately after sample collection) take the following steps:

1. If the samples require a specific storage temperature, then cool the samples and maintain the temperature prior to shipping. For example, place enough ice in each sample cooler to maintain the temperature at 4° C until processing begins at the testing laboratory.

2. Be aware of holding time requirements for project-specific analytes and arrange the sample shipping schedule accordingly.

3. Place samples in secure storage (i.e., locked room or vehicle) or keep them in the possession of TWE sampling personnel before shipment. Lock and secure any sample storage areas to maintain sample integrity and COC requirements.

4. Store samples in the dark (e.g., keep coolers shut).

At the sample processing area (just prior to shipping), do the following:

1. Check sample containers against the COC form to account for all samples intended for shipment.

2. Choose cooler(s) of appropriate size and make sure they are clean of gross contamination inside and out. If the cooler has a drain, close the drain and secure it with duct tape.

3. Line the cooler with bubble wrap and place a large plastic bag (preferably with a thickness of 3 mil), open, inside the cooler.

4. Individually wrap each glass container (which was sealed in a plastic bag at the collection site) in bubble wrap and secure with tape or a rubber band. Place the wrapped samples in the large plastic bag in the cooler, leaving room for ice to keep the samples cold (i.e., 4° C).

5. If temperature blanks have been provided by the testing laboratory, place one temperature blank in each sample cooler.

6. If the samples require a specific storage temperature, add enough wet ice to maintain that temperature during overnight shipping (i.e., 4° C). Always use fresh ice when packing the coolers for shipment and overestimate the amount of ice that will be required. Keep ice in a sealed plastic bag, which is placed in a second sealed plastic bag to prevent leakage. Make sure the openings of both bags are pointing up. Avoid separating the samples from the ice with excess bubble wrap because it may insulate the samples from the ice. After adding all samples and ice to the cooler, use bubble wrap (or other available clean packing material) to fill any empty space and prevent the samples from shifting during transport.

7. If possible, consolidate all VOA samples in a single cooler and ship them with (a) trip blank(s) if the project-specific QA project plan calls for them.

8. Sign, date, and include any tracking numbers provided by the shipper on the COC form. Remove the back (pink) copy of the original COC form and retain this copy for the project records.

9. Seal the rest of the signed COC form in a bag and tape the bag to the inside of the cooler lid. Each cooler should contain an individual COC form for the samples contained inside it. If time is short and it becomes necessary to combine all the samples onto a single set of COC forms and ship multiple coolers together, then indicate on the outside of the appropriate cooler, "Chain-of-Custody Inside."

10. After the cooler is sufficiently packed to prevent shifting of the containers, close the lid and seal it with fiber-reinforced packing tape. Tape the cooler around the opening, joining the lid to the bottom, and around the circumference of the cooler at both hinges.

11. As security against unauthorized handling of the samples, apply two COC seals across the opening of the cooler lid (provided with example field forms). Place one seal on the front right portion of the cooler and one on the back left. Be sure the seals are properly affixed to the cooler to prevent removal during shipment. Additional clear tape across the seal should be added to maintain seal integrity during shipping.

SAMPLE SHIPPING

Hand Delivery to the Testing Laboratory

1. Notify the laboratory contact and the TWE project QA/QC coordinator that samples will be delivered to the laboratory and the estimated arrival time.

2. When hand-delivering environmental samples, make sure the testing laboratory receives them on the same day that they were packed in the coolers.

3. Fax or scan and e-mail copies of all COC forms to the TWE project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after it has been faxed. Field personnel may need to come into the office to make copies. Never leave the original COC form in the custody of non-TWE staff.

Shipped by Commercial Carrier to the Laboratory

1. Apply a mailing label to the cooler with destination and return addresses, and add other appropriate stickers, such as “This End Up,” “Fragile,” and “Handle With Care.” If the shipment contains multiple coolers, indicate on the mailing label the number of coolers that the testing laboratory should expect to receive (e.g., 1 of 2; 2 of 2). Place clear tape over the mailing label to firmly affix it to the cooler and to protect it from the weather. This is a secondary label in case the air bill is lost during shipment.

2. Fill out the air bill and fasten it to the handle tags provided by the shipper (or the top of the cooler if handle tags are not available).

3. Notify the laboratory contact and the TWE project QA/QC coordinator that samples will be shipped and the estimated arrival date and time.

Fax or scan and e-mail copies of all COC forms to the TWE project QA/QC coordinator. Note: It may be necessary to photocopy the COC form on a slightly darker setting so the form is readable after faxing. Field personnel may need to come into the office to make copies. Never leave the original COC form in the custody of non-TWE staff.

Note: Modified from S0P AP-01 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

STANDARD OPERATING PROCEDURE (SOP) 6
FIELD DOCUMENTATION (See Note)

SCOPE AND APPLICATION

This SOP describes the procedure for accurate record-keeping in the field for the purposes of ensuring that samples can be traced from collection to final disposition. It is general in nature, and therefore applies to a broad range of sampling environments and conditions. Document all information relevant to field operations properly to ensure that activities are accounted for in written records to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. Several types of field documents are used for this purpose and should be consistently used by field personnel when appropriate. Field documentation should include only a factual description of site-related activities and observations. Field personnel should not include superfluous comments or speculation regarding the field activities or observations.

FIELD LOGBOOKS

During field sampling events, field logbooks must be used to record all daily activities. The purpose of the field logbook is to document events and record data measured in the field to the extent that someone not present at the site could reconstruct the activity without relying on the memory of the field crew. The project manager (or designee) should issue a field logbook to the appropriate site personnel for the direction of onsite activities (e.g., reconnaissance survey team leader, sampling team leader). It is this designee's responsibility to maintain the site logbook while it is in his or her possession and return it to the project manager. Make entries in the field logbook as follows:

1. Document all daily field activities in indelible ink in the logbook and make no erasures. Make corrections with a single line-out deletion, followed by the author's initials and the date. The author must initial and date each page of the field logbook. The author must sign and date the last page at the end of each day, and draw a line through any blank space remaining on the page below the last entry.

2. Write the project name, dates of the field work, site name and location (city and state), and TWE job number on the cover of the field logbook. If more than one logbook is used during a single sampling event, then annotate the upper right-hand corner of the logbook (e.g., Volume 1 of 2, 2 of 2) to indicate the number of logbooks used during the field event. Secure all field logbooks when not in use in the field. The following is a list of the types of information that is appropriate for entry in the field notebook:

- Project start date and end date
- Date and time of entry (24-hour clock)
- Time and duration of daily sampling activities
- Weather conditions at the beginning of the field work and any changes that occur throughout the day, including the approximate time of the change (e.g., wind speed and direction, rain, thunder, wave action, current, tide, vessel traffic, air and water temperature, thickness of ice if present)
- Name and affiliation of person making entries and other field personnel and their duties, including what times they are present
- The location and description of the work area, including sketches, map references, and photograph log, if appropriate
- Level of personal protection being used
- Onsite visitors (names and affiliations), if any, including what times they are present
- The name, agency, and telephone number of any field contacts
- Notation of the coordinate system used to determine the station location

- The sample identifier and analysis code for each sample to be submitted for laboratory analysis, if not included on separate field data sheets
- All field measurements made (or reference to specific field data sheets used for this purpose), including the time of collection and the date of calibration, if appropriate
- The sampling location name, date, gear, water depth (if applicable), and sampling location coordinates, if not included on separate field data sheets
- For aquatic sampling, the type of vessel used (e.g., size, power, type of engine)
- Specific information on each type of sampling activity
- The sample type (e.g., groundwater, soil, surface sediment), sample number, sample tag number, and any preservatives used, if not included on separate field data sheets
- Sample storage methods
- Cross-references of numbers for duplicate samples
- A description of the sample (source and appearance, such as soil or sediment type, color, texture, consistency, presence of biota or debris, presence of oily sheen, changes in sample characteristics with depth, presence/location/thickness of the redox potential discontinuity [RPD] layer, and odor) and penetration depth, if not included on separate field data sheets
- Estimate of length and appearance of recovered cores, if not included on separate field data sheets
- Photographs (uniquely identified) taken at the sampling location, if any
- Details of the work performed
- Variations, if any, from the project-specific sampling and analysis plan (SAP) or standard operating protocols and reasons for deviation
- Details pertaining to unusual events that might have occurred during sample collection (e.g., possible sources of sample contamination, equipment failure, unusual appearance of sample integrity, control of vertical descent of the sampling equipment)
- References to other logbooks or field forms used to record information (e.g., field data sheets, health and safety log)
- Any field results not appearing on the field data sheets (if used), including station identification and location, date, and time of measurement
- Sample shipment information (e.g., shipping manifests, chain-of-custody (COC) form numbers, carrier, air bill numbers, time addresses)
- A record of quantity of investigation-derived wastes (if any) and storage and handling procedures.

3. During the field day, as listed above, record in the logbook a summary of all site activities. Provide a date and time for each entry. The information need not duplicate anything recorded in other field logbooks or field forms (e.g., site health and safety officer's logbook, calibration logbook, field data sheets), but should summarize the contents of the other logbooks and refer to the pages in these logbooks for detailed information.

4. If measurements are made at any location, record the measurements and equipment used, or refer to the logbook and page number(s) or field forms on which they are recorded. All maintenance and calibration records for equipment should be traceable through field records to the person using the instrument and to the specific piece of instrumentation itself.

5. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field logbooks to be copied. A discussion of copy distribution is provided below.

FIELD DATA FORMS

Occasionally, additional field data forms are generated during a field sampling event (e.g., groundwater monitoring form, sediment core profile form, water quality measurement form) to record the relevant sample information collected. For instructions regarding the proper identification of field data forms,

sampling personnel should consult the project-specific SAP. Upon completion of the field sampling event, the sampling team leader will be responsible for submitting all field data forms to be copied. A discussion of copy distribution is provided below.

PHOTOGRAPHS

In certain cases, photographs (print or digital) of sampling stations may be taken using a camera-lens system with a perspective similar to the naked eye. Ensure that photographs include a measured scale in the image, when practical. If you take photographs of sample characteristics and routine sampling activities, avoid using telephoto or wide-angle shots, because they cannot be used in enforcement proceedings. Record the following items in the field logbook for each photograph taken:

1. The photographer's name or initials, the date, the time of the photograph, and the general direction faced (orientation)
2. A brief description of the subject and the field work shown in the picture
3. For print photographs, the sequential number of the photograph and the roll number on which it is contained
4. For digital photographs, the sequential number of the photograph, the file name, the file location, and back-up disk number (if applicable).

Upon completion of the field sampling event, the sampling team leader is responsible for submitting all photographic materials to be developed (prints) or copied (disks). Place the prints or disks and associated negatives in the project files (at the TWE project manager's location). Make photocopies of photo logs and any supporting documentation from the field logbooks, and place them in the project files with the prints or disks.

EQUIPMENT CALIBRATION RECORDS

Record in the field logbook all equipment calibration records, including instrument type and serial number, calibration supplies used, calibration methods and calibration results, date, time, and personnel performing the calibration. At the beginning of each day, calibrate all equipment used during the investigation, in accordance with the manufacturers' recommendations.

DISTRIBUTION OF COPIES

At TWE offices, make two copies of all field logbooks and additional field data forms. Stamp the first copy with a "COPY" stamp, and place it in the project file to be available for general staff use. Stamp the second copy with a "FILE" stamp, and place it in the data management file with the laboratory data packages, to be used by the data management and quality assurance staff only. Place the original field logbooks and forms in a locked file cabinet.

SET-UP OF LOCKING FILE CABINET

Place each project in its own file folder in a locking file cabinet. On the folder label, include the project name and contract number. Each project folder will include up to six kinds of files:

- Field logbook(s)
- Additional field data forms
- Photographs
- COC forms
- Acknowledgment of Sample Receipt forms
- Archive Record form (to be completed only if samples are archived at a TWE field storage facility or TWE laboratory).

Note: Modified from S0P AP-02 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

STANDARD OPERATING PROCEDURE (SOP) 7
SAMPLE LABELING (See Note)

SCOPE AND APPLICATION

This SOP describes the general procedures for labeling samples, and the three kinds of labels that can be used on a project (i.e., sample labels, sample tags, and internal sample labels). It is general in nature, and therefore applies to a broad range of sampling environments and conditions. Consult the project-specific sampling and analysis plan (SAP) to determine the exact sample identifiers and sample labels that are required for a given project. If they are not specified in the SAP, then follow the designations below.

SAMPLE IDENTIFIERS

Before field sampling begins, establish sample identifiers to be assigned to each sample as it is collected. Sample identifiers consist of codes designed to fulfill three purposes: 1) to identify related samples (i.e., replicates) to ensure proper data analysis and interpretation, 2) to obscure the relationships between samples so that laboratory analysis will be unbiased by presumptive similarities between samples, and 3) to track individual sample containers to ensure that the laboratory receives all material associated with a single sample. To accomplish these purposes, each container may have three different codes associated with it: the sample identifier, the sample number, and the sample tag number. These codes and their use are described as follows:

Sample Identification Code—The sample identification code (Sample ID) is a unique designation that identifies where and how the sample was collected. The sample identifier is recorded in the field logbook *only* and is not provided on the sample label or chain-of-custody (COC) form. The sample identifier is a multiple-part code. The first component begins with the letter abbreviation; for example, "SJBS" or "SJPS" to designate the sediment sample s collected from a pylon location or along the submerged bank of the main channel. The second part is a sequence number for the order in which locations were sampled. For example, "001" would designate sample location 1. The third part contains an abbreviation for the type of sample collected, such as grab samples (GR). For samples that are collected on a routine basis from a single location, the final component of the sample identifier would be a date designation, e.g. 2012. If appropriate, add a supplemental component to the sample identifier to code field duplicate samples and splits. This can be accomplished either by identifying the duplicate or split with a different location number or by using a single letter (i.e., a suffix of "A" and "B") to indicate field duplicates or splits in the final component of the sample identifiers. For equipment decontamination blanks, assign sequential numbers starting at 900 instead of station numbers. Use a sample type code that corresponds to the sample type for which the decontamination blank was collected. Additional codes may be adopted, if necessary, to reflect sampling equipment requirements (see project-specific SAP).

Examples of sample IDs are as follows:

- SJPS003-GR: Sediment sample collected from location 3 of a series of proposed pylon locations.
- SJPS005-GR: A duplicate sediment sample collected any pylon location that doesn't have a location ID of 005.
- SJBS002-GR2012: Sediment sample collected from location 2 along the submerged bank of the San Jacinto River in 2012 under an annual sampling program.

Uniqueness of Sample Number—The sample number is an arbitrary number assigned to each distinct sample or split that is shipped to the laboratory for separate analysis. The sample number appears on the sample containers and the COC forms. Each sample will be assigned a unique sample number. All aliquots of a composited field sample will have the same sample number. In cases where samples consist of multiple bottles from the same location, assign each bottle the same sample number and time.

However, assign replicates from the same location different sample numbers and times. Sample numbers of related field replicates will not necessarily have any shared content. Each field split of a single sample will also have a different sample number and time. Where multimedia sampling is being conducted, the sample number may include an additional two digit code specifying the type of media sampled. TWE default codes are as follows:

- SS—Surface soil
- BH—Subsurface soil or rock (typically from borehole)
- GW—Groundwater
- SW—Surface water
- PW—Pore water
- SD—Sediment
- BT—Biota or biological tissue

This code would be placed after the four digit location ID, e.g., SJPS-SD001-GR. Variances in the sample numbering scheme will be described in the project-specific SAP for the field event.

Tag Number—If required by the SAP, attach a different tag number to each sample container. If the amount of material (i.e., everything associated with a single sample number) is too large for a single container, assign each container the same sample number and a different sample tag. A sample will also be split between containers if a different preservation technique is used for each container (i.e., because different analyses will be conducted). The sample tag number is a unique five- or six-digit number assigned to each sample label (or "tag") for multiple bottles per sample. The tag number provides a unique tracking number to a specific sample bottle. This allows for greater flexibility in tracking sample bottles and assists in field quality control when filling out documentation and shipping. Record tag numbers on the COC form. Laboratories use tag numbers only to confirm that they have received all of the containers that were filled and shipped.

SAMPLE LABELS

Sample labels are designed to uniquely identify each individual sample container that is collected during a sampling event. If possible, field sampling teams will be provided with preprinted sample labels, which must be affixed to each sample container used. Fill in any remaining blanks on the labels at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- A unique number (commonly referred to as the "Tag Number") that is preprinted on the label consisting of five or six digits; used to identify individual containers.

SAMPLE TAGS

Sample tags are designed to be affixed to each container that is used for a sample. Sample tags are required only for environmental samples collected in certain U.S. Environmental Protection Agency (EPA) regions (e.g., EPA Region 5). If required, field crews are provided with preprinted sample tags. Attach sample tags to each individual sample container with a rubber band or wire through a reinforced hole in the tag. Mark all sample tag entries with indelible ink. Fill out the tags at the time the samples are collected, documenting the following information:

- Sample number
- Site name or project number

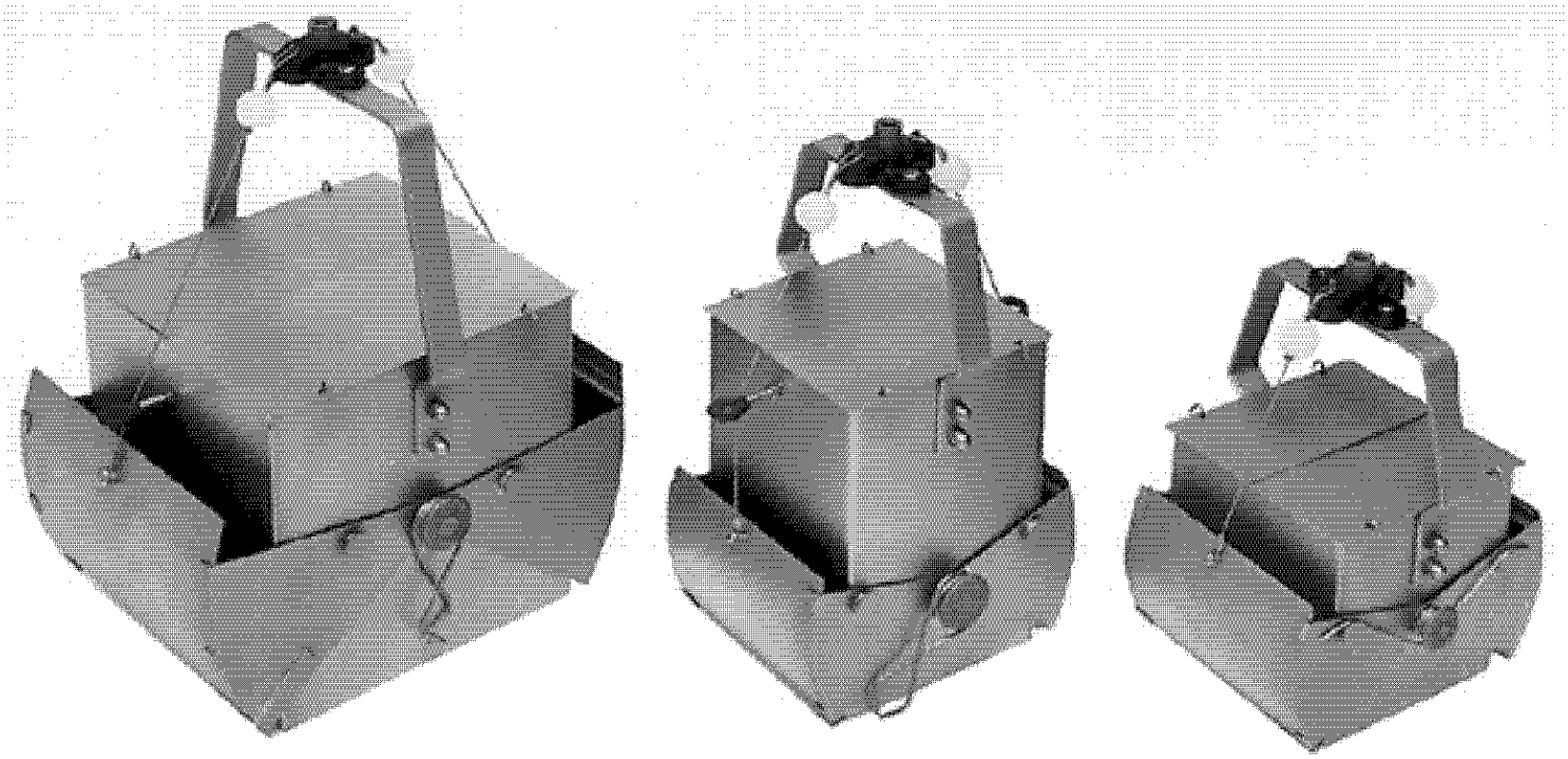
- Date and time sample is collected
- Initials of the samplers
- Preservatives used, if any
- Type of analysis.

A space for the laboratory sample number (provided by the laboratory at log-in) will also be provided on the sample tag.

Note: Modified from S0P AP-04 developed by Integral Consulting, Inc., for the sake of maintaining consistency in sampling efforts with the SJRWP Superfund Site.

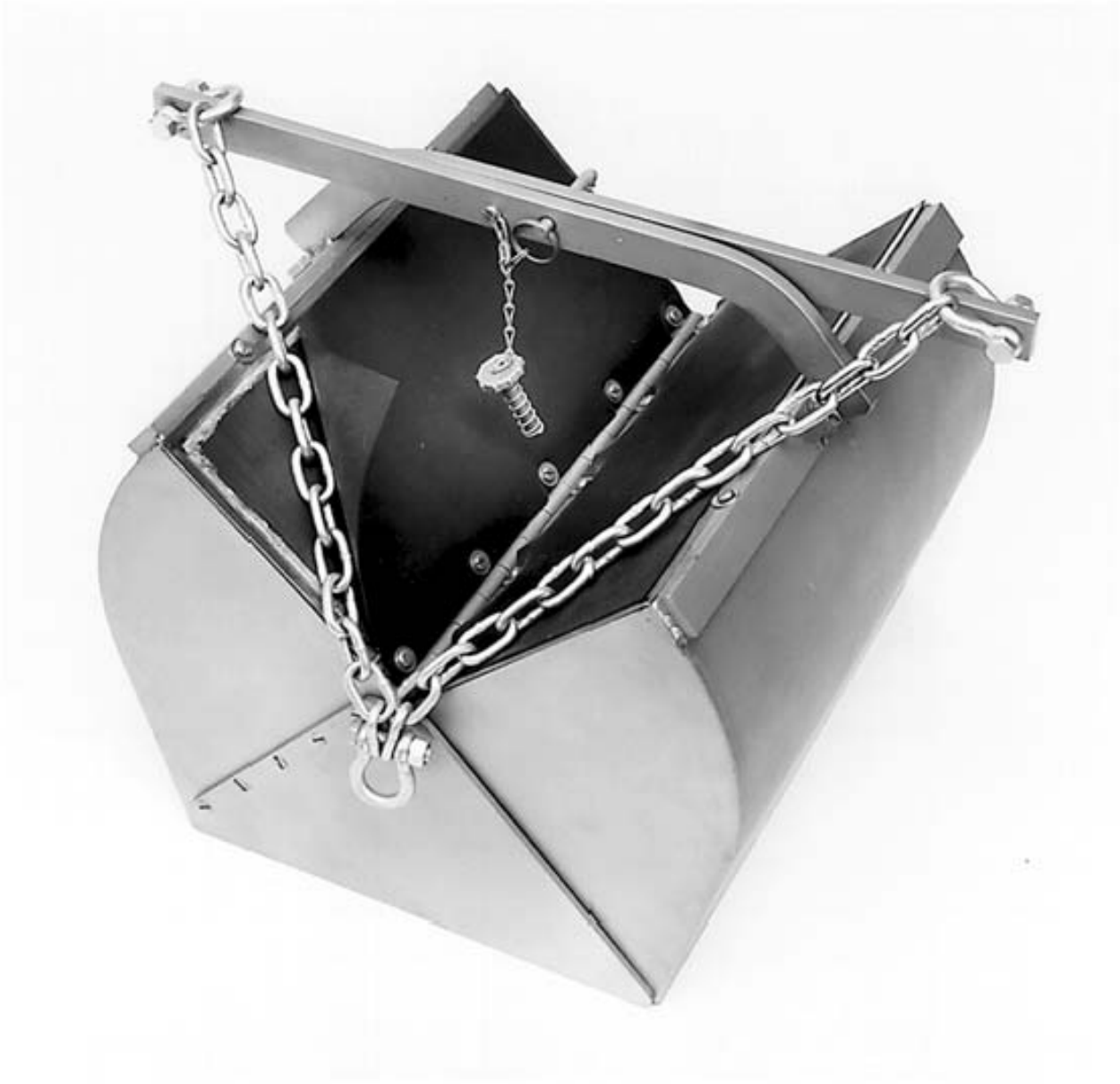
ATTACHMENT 4

Sampler Types



Ekman Grab Samplers

Ponar Grab Sampler



Van Veen Grab Sampler

Beeker Sampler

ATTACHMENT 5

CHAIN-OF-CUSTODY EXAMPLE

☐ ALS Laboratory Group
10450 Stancliff Rd., Suite 210
Houston, Texas 77099
Tel. +1 281 530 5656
Fax. +1 281 530 5887

Chain of Custody Form

Page 1 of 1

☐ ALS Laboratory Group
3352 128th Ave.
Holland, MI 49424-9263
Tel: +1 616 399 6070
Fax: +1 616 399 6185

ALS Project Manager:		ALS Work Order #:	

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order	12.12.TBD	Project Name	SJRF Baseline Site Assessment	A	Dioxins/Furans - 8290A High Res
Work Order	—	Project Number	12.12.TBD	B	
Company Name	Tolunay-Wong Eng. Inc.	Bill To Company	Tolunay-Wong Eng. Inc.	C	
Send Report To	Mark Brotherton	Invoice Attn	Mark Brotherton	D	
Address	10710 S. Sam Houston Pkwy W. Suite 100	Address	Same	E	
				F	
City/State/Zip	Houston, TX 77031	City/State/Zip		G	
Phone	713 722 7064	Phone		H	
Fax	713 777 0341	Fax		I	
e-Mail Address	mbrotherton@tweinc.com	e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	SJPS001-GR	02-14-12	9:45	SD	8	1	X										
2	SJPS002-GR		11:[illegible]	SD	8		[illegible]										
3	SJPS003-GR		14:[illegible]	SD	8		X										
4	SJPS004-GR		15:40	SD	8	1	X										
5	SJPS005-GR		17:00	SD	8	1	X										
6	SDFW-9005		13:00	FW	8	1	X										
7																	
8																	
9																	
10																	

Sampler(s) Please Print & Sign	Shipment Method	Required Turnaround Time: (Check Box)	Results Due Date:
	Hand Delivered	☐ STD 10 Wk Days ☐ 5 Wk Days ☒ 2 Wk Days ☐ 24 Hour ☐ Other	

Relinquished by:	Date:	Time:	Received by:
Field Lead	02-14-12	18:15	Lab Custodian
Relinquished by:	Date:	Time:	Received by (Laboratory):
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):

Notes:

Cooler ID	Cooler Temp

QC Package: (Check One Box Below)
☐ Level II Std QC ☐ TRRP Checklist
☐ Level III Std QC/Raw Date ☐ TRRP Level IV
☒ Level IV SW846/CLP
☐ Other

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Laboratory Group.
2. Unless otherwise agreed in a formal contract, services provided by ALS Laboratory Group are expressly limited to the terms and conditions stated on the reverse.
3. The Chain of Custody is a legal document. All information must be completed accurately.